SOIL SURVEY OF

Cowlitz Area, Washington

United States Department of Agriculture
Soil Conservation Service
in cooperation with
Washington Agricultural Experiment Station

Issued February 1974

Major fieldwork for this soil survey was done in the period 1955–63. Soil names and descriptions were approved in 1966. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1963. This survey was made cooperatively by the Soil Conservation Service and the Washington Agricultural Experiment Station. It is part of the technical assistance furnished to the Cowlitz Soil and Water Conservation District.

Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

THIS SURVEY contains information that can be applied in managing farms, ranches, and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for agriculture, industry, and recreation.

Locating Soils

All of the soils of the Cowlitz Area are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the capability unit in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the descriptions of the capability units and woodland groups.

Foresters and others can refer to the section "Woodland," where the soils of the Area are grouped according to their suitability for trees.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Wildlife and Fish."

Community planners and others can read about soil properties that affect the choice of sites for nonindustrial buildings and for recreation areas in the section "Town and Country Planning."

Engineers and builders can find, under "Engineering," tables that contain estimates of soil properties and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers in the Cowlitz Area may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the survey area given in the section "General Nature of the Area."

Cover picture: **Iris on Newberg silt loam, silty variant.**

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SOIL SURVEY OF COWLITZ AREA, WASHINGTON

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE WASHINGTON AGRICULTURAL EXPERIMENT STATION

THE COWLITZ AREA is in the southwestern part of Washington (fig. 1). It covers most of the western half and some of the southern part of Cowlitz County. The Columbia River forms part of its southern boundary.

The survey area is 26 miles north of Portland, Oregon, and about 110 miles south of Seattle, Washington. It is irregular in shape and has an area of 377,480 acres. Elevation ranges from 4 feet above sea level along the flood plains of the Columbia River to about 2,700 feet in the coastal range in the northwestern part of the county and to about 3,000 feet in the Cascade Mountains in the southeastern part.

Annual precipitation ranges from 38 to 120 inches. Most of the precipitation falls late in fall, in winter, and early in spring.

Most of the eastern part of Cowlitz County is outside the survey area. It is timberland owned principally by large timber companies and includes part of the Gifford Pinchot National Forest.

The major farm crops are hay and pasture for livestock and dairy enterprises, and truck, berry, and specialty crops. Forest products are the principal crops of the survey area. Forests are principally Douglas-fir, red alder, western redcedar, and western hemlock. Manufacturing concerns, mostly the lumber and paper products industries, employ most of the people in the survey area.

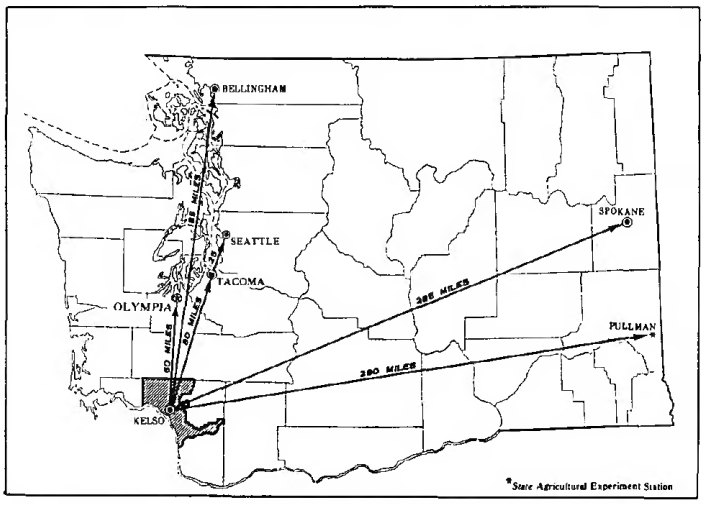

Figure 1.—Location of Cowlitz Area in Washington.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in the Cowlitz Area, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey (*10*).[1]

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Kelso and Loper, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases.

[1] Italic numbers in parentheses refer to Literature Cited, p. 110.

The name of a soil phase indicates a feature that affects management. For example, Kelso silt loam, 0 to 8 percent slopes, is one of several phases within the Kelso series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series or of different phases within one series. One such kind of mapping unit, a soil complex, is shown on the soil map of the Cowlitz Area.

A soil complex consists of areas of two or more soils, so intermingled or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Loper-Bear Prairie complex, 3 to 15 percent slopes, is an example.

In most areas surveyed, there are places where the soil material is so rocky, so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Riverwash is a land type in the Cowlitz Area.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, managers of woodland and rangeland, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others, then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in the Cowlitz Area. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in an area, who want to compare different parts of an area, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The soil associations in the Cowlitz Area are described in the following pages.

1. Germany-Olympic Association

Dominantly moderately steep and steep, well-drained soils that formed in wind-laid silt and weathered basalt and andesite; on uplands

This soil association is in the southwestern part of the Cowlitz Area. It is characterized by rolling hills, steep lower slopes, and broad, gently sloping ridgetops. Steep valley walls border winding streams that generally flow south and southeast to the Columbia River. Flood plains are a few feet to 750 feet wide. In some places the streams are entrenched in hard bedrock and have no flood plain. Elevation ranges from 5 feet at the Columbia River to about 1,400 feet at the northern edge of the survey area. The average annual precipitation ranges from 45 to 70 inches. The mean annual air temperature is about 51° F., and the frost-free season is 165 to 180 days.

This association makes up about 11 percent of the survey area. It is about 70 percent Germany soils and 25 percent Olympic soils. The remaining acreage is Olequa and Camas soils, Clato soils, coarse variant, and rock outcrop.

The gently sloping Germany and Olympic soils are on ridgetops, and the steep to very steep Germany and Olympic soils are on the hillsides and mountainsides. Olequa soils are about a half mile north of the Columbia River, parallel to the river. These gently sloping and rolling soils are on hillsides and broad ridges at an elevation of about 550 feet. The nearly level Clato soils, coarse variant, and Camas soils are on flood plains.

The well-drained Germany soils formed in very deep, wind-laid deposits. They have a surface layer of dark-brown silt loam and a subsoil of brown heavy silt loam. Depth to basalt bedrock is more than 6 feet in most places.

The well-drained Olympic soils formed in weathered

basalt and andesite. They have a surface layer of dark-brown silt loam and a subsoil of dark reddish-brown and dark-brown silt loam and silty clay loam. Depth to basalt or andesite bedrock is more than 6 feet in most places.

Most of this association is coniferous forest. Douglas-fir grows faster in this association than in any other part of the survey area. Small areas have been cleared, mainly along the streams and on the broad, gently sloping ridges. Hay and pasture (fig. 2) are the principal crops. Potatoes, cane fruits, and strawberries are also grown. Beef and dairy farms are the principal farm enterprises. Most farming is a part-time operation; farm operators work elsewhere to supplement their income.

Deer, elk, black bear, beaver, blue grouse, and ruffed grouse can be found in the hills. Rainbow trout and silver and chinook salmon are in the larger streams. The association is well suited to hunting and fishing.

2. Bear Prairie-Loper Association

Dominantly steep, well-drained soils that formed in volcanic ash and weathered basalt and andesite; on uplands

This soil association is in the northwestern part of the Cowlitz Area in steep mountainous terrain. It occupies a broad divide that separates the watersheds of the Columbia, Chehalis, and Cowlitz Rivers and Stillwater Creek. The soils formed mainly in residuum derived from basalt, andesite, and sandstone. Ridges that developed in andesite and basalt have gently sloping sides and moderately broad tops. The ridges that developed

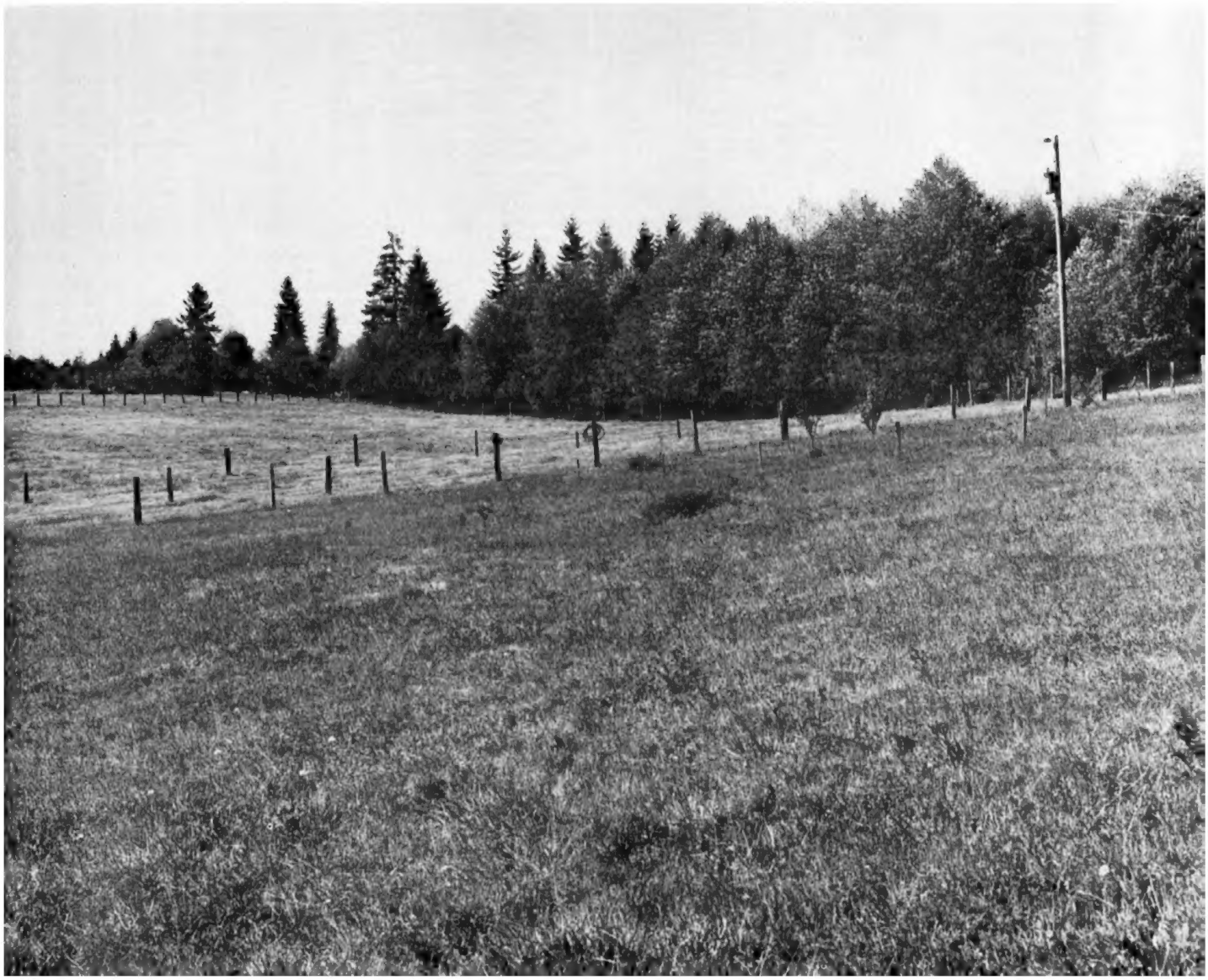

Figure 2.—Pasture on Germany silt loam, 0 to 8 percent slopes, in soil association 1.

in sandstone are sharp, narrow, and strongly sloping, and the drainageways have short, stubby, lateral branches. The narrow valleys have deeply entrenched, swiftly flowing, perennial and intermittent streams. Rock outcrop and cobblestones are common. Elevation ranges from 400 to 2,700 feet. The average annual precipitation is 50 to 80 inches. The mean annual air temperature is about 47° F., and the frost-free season is 125 to 150 days.

This association makes up about 9 percent of the survey area. It is about 60 percent Bear Prairie soils, 30 percent Loper soils, 9 percent Vader soils, and 1 percent Rock land.

The gently sloping Bear Prairie and Loper soils are on moderately broad ridges and hillsides, and the steep Bear Prairie and Loper soils are on mountainsides. Many of the steep soils are eroded. The strongly sloping Vader soils are on narrow ridges, and the steep Vader soils are on mountainsides. Many of the steep soils are eroded (fig. 3). There are small patches of Rock land throughout the association.

The well-drained Bear Prairie soils formed mainly in weathered basalt and andesite. The surface layer is very dark brown and very dark grayish-brown silt loam, and the subsoil is dark-brown silt loam. Bedrock is at a depth of more than 5 feet.

The well-drained Loper soils formed in weathered basalt and andesite. The surface layer is very dark brown cobbly silt loam, and the subsoil is dark-brown gravelly silt loam and very gravelly silt loam. The depth to bedrock ranges from 2.5 to more than 5 feet.

Most of this association is forested and is used mainly

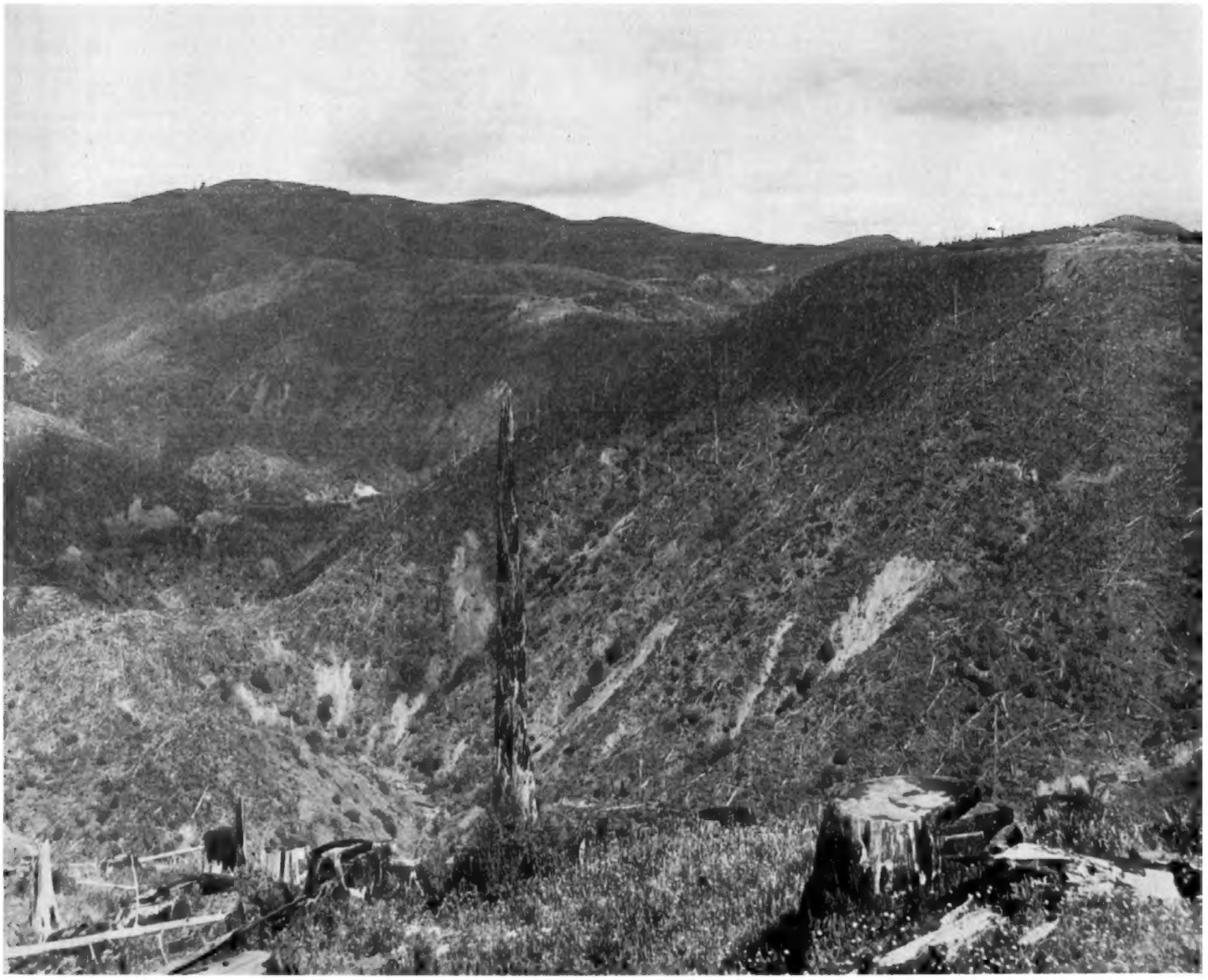

Figure 3.—**Loper-Bear Prairie complex, 30 to 50 percent slopes, in soil association 2.**

for timber production and wildlife habitat. The vegetation is mostly Douglas-fir and smaller stands of western hemlock; red alder, western redcedar, silver fir, and broadleaf maple. Salal, swordfern, bracken, salmonberry, and red and blue huckleberry grow in the logged-off areas.

Deer, elk, black bear, beaver, blue and ruffed grouse, and band-tailed pigeons are found in this association. The association is well suited to hunting.

3. Olympic-Olequa Association

Dominantly gently sloping to steep, well-drained soils that formed in weathered basalt, andesite, sandstone, and shale; on uplands

This association occupies a broad, north-south belt west of the Cowlitz River in the western part of Cowlitz Area and a small tract in the northwestern part. The landscape in most of the western and central part is characterized by large hills that have broad, undulating ridges and hilltops and steep hillsides. Some of the toe slopes are rolling to gently sloping. Valleys are narrow and the perennial streams have narrow flood plains. Intermittent streams have no flood plains. Soils in the eastern part of the association are gently sloping on dissected terraces and steep to very steep on the terrace fronts. Flood plains are as much as 2,000 feet wide. Streams flow in an easterly direction toward the Cowlitz River, except in the southern part, where they flow southward to the Columbia River. Near the northern edge of this association, in the vicinity of Ryderwood, some soils are rolling, some are nearly level or gently sloping, and the flood plains are no more than 1,000 feet wide. Elevation ranges from 30 to 1,935 feet. The average annual precipitation ranges from 45 to 70 inches. The average annual air temperature is 50° F., and the frost-free season is 165 to 180 days.

This association makes up about 15 percent of the survey area. It is about 45 percent Olympic soils, 40 percent Olequa soils, 9 percent Kelso soils, and 6 percent Clato and Rose Valley soils. The rest is small acreages of Kalama, Godfrey, McBee, Minniece, and Vader soils.

The undulating Olympic and Olequa soils are on broad ridges and hilltops, the steep soils are on hillsides, and the rolling to sloping soils are on toe slopes. The steep Vader soils are on mountainsides and the sloping Vader soils are on narrow ridges. The nearly level to steep Kelso, Rose Valley, Kalama, McBee, Minniece, and Olequa soils are on dissected terraces near major streams. The nearly level Clato and Godfrey soils are on flood plains.

The well-drained Olympic soils formed in weathered basalt and andesite. They have a surface layer of dark-brown silt loam and a subsoil of dark reddish-brown and dark-brown silt loam and silty clay loam. Depth to bedrock is more than 6 feet in most places.

The well-drained Olequa soils formed in material derived from shale and sandstone. They have a surface layer of dark-brown and very dark grayish-brown silt loam and a subsoil of dark-brown silty clay loam. Olequa soils are more than 5 feet deep over shale or sandstone.

Most of this association is forested and is used mainly for timber production and wildlife habitat. The principal tree species are Douglas-fir, western redcedar, western hemlock, red alder, and bigleaf maple. A few black cottonwood trees grow along the streams. Understory plants are swordfern, salal, bracken, vine maple, and salmonberry. Most of the nearly level to gently sloping soils on terraces have been cleared and are cropped. There are a few small farms in the hills. Hay and pasture, cane fruit, strawberries, and small grain are the main crops.

Deer, elk, black bear, and ring-necked pheasants can be found in the hills. Ducks and geese are abundant. Rainbow trout is the principal sport fish. The association is well suited to hunting and fishing. Most of the homesites are on the terraces of the Cowlitz and Columbia Rivers.

4. Seaquest-Olympic Association

Dominantly gently sloping to steep, well-drained soils that formed in old sediments and weathered basalt and andesite; on uplands

This association occupies the northeastern part of the survey area. The landscape is hilly. It is characterized by broad, gently sloping to rolling ridges and hilltops, steep hillsides, nearly level to rolling toe slopes, and nearly level to rolling outwash terraces. The Toutle River and the South Fork of the Toutle River flow westward through this association. In some places the rivers have flood plains and terraces several hundred feet wide, and in others they have cut deep gorges through the basalt bedrock. In the narrow valleys of the hills section, small streams have no flood plains. In the nearly level to rolling outwash areas, some small streams have very narrow flood plains. Silver Lake, in the southern part of this association, was formed by large quantities of outwash material from alpine glaciers in the Toutle River and South Fork of the Toutle River, damming the outlet of a north-drained basin *(9)*. Elevation ranges from 100 to 1,760 feet. The average annual precipitation is 50 to 65 inches. The average annual air temperature is about 50° F., and the frost-free season is 160 to 180 days.

This association makes up about 14 percent of the survey area. It is about 30 percent Seaquest soils, 25 percent Olympic soils, 10 percent Sara soils, 10 percent Mart soils, 10 percent Toutle soils, 5 percent Speelyai soils, 5 percent Gee soils, and 5 percent Semiahmoo soils. In places Gee soils are rolling, and Speelyai soils are very steep. The nearly level Toutle soils are on flood plains and terraces, and the steep Toutle soils are on terrace fronts. The nearly level Semiahmoo soils are in depressions.

The gently rolling to steep Olympic and Mart soils are on ridges and hills, and the undulating to rolling Olympic and Mart soils are on toe slopes. The gently sloping to rolling Seaquest and Sara soils are on hillsides. The nearly level Speelyai and Gee soils are on terraces.

The dominant soils in this association are well drained. Seaquest soils formed in old alluvial sediments.

They have a surface layer of very dark brown silt loam and a subsoil of dark-brown and brown silty clay loam and clay loam. Olympic soils formed in weathered basalt and andesite. They have a surface layer of dark-brown silt loam and a subsoil of dark reddish-brown and dark-brown silt loam and silty clay loam. Depth to bedrock is more than 6 feet in most places. The other soils range widely in drainage and texture.

Most of the association is forested and is used for timber production and wildlife habitat. The principal tree species are Douglas-fir, red alder, western redcedar, bigleaf maple, western hemlock, black cottonwood, Oregon white oak, cascara, and Oregon ash. Understory plants are salal, salmonberry, swordfern, brackenfern, vine maple, elderberry, hazel, evergreen blackberry, and willow. Small farms are in cleared areas. The main crops are hay, pasture, small grain, cane fruits, and strawberries.

There are black bear and deer in the hills, spinyray fish, bass, and rainbow trout in Silver Lake, and steelhead and rainbow trout, and silver and chinook salmon in the Toutle River. The association also has a good population of beaver, ducks, and geese. It is well suited to hunting and fishing.

5. Olympic Association

Dominantly gently sloping to steep, well-drained soils that formed in weathered basalt and andesite; on uplands

This association occupies a broad, north-south belt in the central part of the Area, east of the Cowlitz and Columbia Rivers. The landscape is characterized by large hills and mountains that have broad, gently sloping to rolling ridges, steep hillsides and mountainsides, and undulating to steep foot slopes. There are also scattered areas of rock outcrop, of soils that are shallow over bedrock, and of cobbly soils. Streams flow westward toward the Cowlitz and Columbia Rivers and southward toward the Lewis River. Stream valleys are narrow and have steep sides. Most streams are deeply entrenched and have no flood plains. The Coweman and Kalama Rivers have narrow flood plains. Elevation ranges from 30 to 1,600 feet. Average annual precipitation ranges from 40 to 70 inches. The average annual air temperature is about 50° F., and the frost-free season is 165 to 180 days.

This association makes up about 26 percent of the survey area. Olympic soils make up about 90 percent of the association. The remaining acreage consists of Mart, Coweeman, Sauvola, Gee, Rose Valley, Kalama, and Olequa soils, and Rock land.

Olympic, Mart, Kalama, and Olequa soils, and Rock land are on large hills and mountains. The gently sloping to rolling soils are on ridges, the steep soils are on hillsides and mountainsides, and the rolling to undulating soils are on foot slopes. The undulating to steep Coweeman, Gee, Rose Valley, and Sauvola soils are on foot slopes.

The well-drained Olympic soils formed in weathered basalt and andesite. They have a surface layer of dark-brown silt loam and a subsoil of dark reddish-brown and dark-brown silt loam and silty clay loam. Depth to bedrock is greater than 6 feet in most places.

Most of this association is forested and is used mainly for timber production and wildlife habitat. The principal tree species are Douglas-fir, red alder, western redcedar, bigleaf maple, western hemlock, white fir, vine maple, salmonberry, Oregon grape, and hazel. Small farms and homesites are in cleared areas. Principal crops are hay, pasture, and small grain.

Black bear, deer, blue grouse, and ruffed grouse can be found in the hills. Steelhead and rainbow trout and silver and chinook salmon are in the larger streams. The association is well suited to hunting and fishing.

6. Cinebar Association

Dominantly steep, well-drained soils that formed in wind-laid silts and volcanic ash; on uplands

This association is in rough mountainous terrain in the southeastern part of Cowlitz Area. The landscape is one of broad, gently sloping to rolling ridges and steep hillsides and mountainsides, many of which are gravelly and cobbly. Streams are deeply entrenched in narrow valleys and, with the exception of Speelyai Creek, have no flood plains. Some streams have cut many feet into hard bedrock. Streams flow in a southerly direction into the Lewis River, Lake Merwin, or the Yale Reservoir. Near the upper part of Lake Merwin and the lower part of Yale Reservoir is an area of nearly level terraces that have steep and very steep terrace fronts. Elevation ranges from 300 to 3,000 feet. The average annual rainfall is from 70 to 120 inches. The average annual air temperature is about 48° F., and the frost-free season is 120 to 140 days.

This soil association makes up about 10 percent of the survey area. It is about 90 percent Cinebar soils, 5 percent Cispus soils, and 5 percent Sifton and other soils.

The steep Cinebar soils are on terrace fronts, broad ridges and hilltops, and mountainsides, and the nearly level Cinebar soils are on terraces bordering the lakes. The steep and very steep Cispus soils are on mountainsides north and east of Cougar, and the nearly level Cispus soils are at the foot of the mountainsides. The nearly level to gently sloping Sifton soils are on the terraces and flood plains of Speelyai Creek.

The well-drained Cinebar soils are very deep. They have a surface layer of very dark brown, dark grayish-brown, and dark-brown gravelly silt loam and a subsoil of dark-brown gravelly silt loam and silt loam. In some places the steep Cinebar soils are gravelly or cobbly.

Most of this association is forested. The steep soils in mountainous areas are used for timber production and wildlife habitat. The nearly level soils on terraces are used for farming. The perimeter of the lakes is used for recreation. The principal vegetation is Douglas-fir, red alder, bigleaf maple, black cottonwood, and vine maple. The principal farm crops are hay and pasture. Most farms have part-time operators.

There are black bear, deer, and blue and ruffed grouse in the hills, rainbow trout in the Lewis River and Yale Reservoir, and rainbow and Kokanee trout in Lake Merwin. This association is moderately well suited to hunting, fishing, and boating.

7. Caples-Clato-Newberg Association

Dominantly nearly level, poorly drained, somewhat poorly drained, and well-drained soils that formed in alluvium; on flood plains

This association is mainly on the flood plains of the Cowlitz and Columbia Rivers and extends for short distances up the Lewis, Kalama, Coweman, and Toutle Rivers. It ranges from a few hundred feet wide near Kalama to about 3 miles wide at Woodland and Longview. Sloughs, old stream channels, and meander cutoffs are common on the Columbia River flood plain. Meandering streams have left some old channels on the lower flood plains along the Cowlitz, Coweman, Kalama, and Lewis Rivers. Most areas near Castle Rock, Willow Grove, Longview, Kelso, and Woodland are diked. Many undiked areas are subject to seasonal flooding. Areas along the Cowlitz River are most likely to flood in winter, but in the southern part, flooding can also be expected in June. Areas along the Columbia River are subject to flooding late in May and in June. Elevation ranges from 5 to 60 feet. The mean annual air temperature is about 52° F., and the frost-free season is 165 to 195 days.

This association makes up about 11 percent of the survey area. It is about 35 percent Caples soils, 25 percent Clato soils, 20 percent Newberg soils, 10 percent Pilchuck soils, 3 percent Newberg soils, silty variant, 3 percent Snohomish soils, and 4 percent Godfrey and other soils.

The somewhat poorly drained and poorly drained, nearly level Caples soils are in smooth, slightly concave areas. The surface layer, in most places, is dark-brown silt loam and silty clay loam, and the subsoil is mottled gray and grayish-brown silty clay loam.

The nearly level, well-drained Clato soils are on flood plains. The surface layer is dark yellowish-brown and dark-brown silt loam. Below this is dark yellowish-brown heavy silt loam. Below a depth of 42 inches, the substratum is sandy in some places.

Newberg soils are nearly level to slightly undulating and have smooth convex slopes. They are well drained and have a surface layer of very dark grayish-brown fine sandy loam. Below this is very dark grayish-brown and dark-brown, stratified fine sandy loam, silt loam, and loamy sand.

Most of this association has been cleared and is either farmed or used for industrial or urban development. The scattered trees that remain are red alder, bigleaf maple, black cottonwood, Douglas-fir, western redcedar, Oregon ash, and willow. Scotch broom has invaded some of the Pilchuck and Newberg soils. Hay and pasture are the principal crops but small grain, strawberries (fig. 4), cane fruits, potatoes, carrots, bulbs, cabbage, mint, sweetcorn, field corn, broccoli, peas, and green beans are also grown. Many farms have part-time operators.

The principal farming area in the Cowlitz Area is on this association. Farms range from a few acres to about 400 acres in size. The average size is 180 acres.

A few deer and beaver inhabit brushy areas along streams. There are also ring-necked pheasant, ducks, and geese in the area and steelhead trout and chinook and silver salmon in the major streams. Smelt runs occur in the Columbia and Cowlitz Rivers. The association is moderately suited to hunting and is well suited to fishing.

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8. Kelso-Minniece-Kalama Association

Dominantly nearly level to moderately steep, moderately well drained and somewhat poorly drained soils that formed in alluvium; on old stream terraces and lake terraces

Most of this association occupies a long narrow strip east of the Cowlitz River. A small acreage is in the southern part of the Area north of the Lewis River. The landscape is one of nearly level to rolling soils on terraces and very steep soils on terrace fronts. The edges of terraces are dissected by streams and their branches that flow southwest to the Cowlitz River and south to the Lewis River. The large streams in this association have flood plains that are about 500 feet wide. Small streams in the narrow valleys have no flood plains. Elevation ranges from 15 to 700 feet. The average annual precipitation is from 40 to 70 inches. The mean annual air temperature is about 51° F., and the frost-free season is 165 to 190 days.

This association makes up about 4 percent of the survey area. It is about 25 percent Kelso soils, 15 percent Minniece soils, 15 percent Kalama soils, 10 percent Olequa soils, 10 percent Toutle soils, 10 percent Rose Valley soils, and 10 percent Gee soils. The remaining 5 percent is small acreages of Hillsboro and other soils.

The soils of this association occur in very irregular and intricate patterns. In general, Kelso, Hillsboro, Minniece, and Olequa soils are below an elevation of 250 feet. They are dominantly nearly level to rolling. The steep soils are on dissected terrace fronts. Rose Valley soils are intermingled with Kelso, Olequa, and Hillsboro soils in depressions. The steep Rose Valley soils are on terrace fronts, and the steep to rolling soils are in areas above the Kelso soils. The rolling to steep Gee and Kalama soils normally occupy higher elevations than the Kelso soils. The nearly level Toutle soils are on the terraces and flood plains, and the steep Toutle soils are on terrace fronts.

The moderately well drained Kelso soils have a surface layer of very dark grayish-brown silt loam and a subsoil of dark-brown silt loam that is mottled below a depth of about 23 inches. The somewhat poorly drained Minniece soils have a surface layer of very dark brown and a very dark grayish-brown silt loam and heavy silt loam. The subsoil is mottled grayish-brown silty clay. The moderately well drained Kalama soils have a surface layer of very dark brown gravelly loam and a subsoil of brown or dark-brown gravelly clay loam and gravelly sandy clay. Below a depth of about 34 inches is extremely firm very gravelly clay loam. The other soils in this association range widely in drainage, texture, and other characteristics.

About half of this association is forested. The rest is in small farms and homesites. The principal tree species are Douglas-fir, red alder, western redcedar, bigleaf maple, Oregon ash, and black cottonwood. Understory plants are swordfern, brackenfern, salal, vine maple, salmonberry, and evergreen blackberry. The principal crops are hay, pasture, and timber. Small acreages of small grain, bulbs, and cane fruit are grown. A large

Figure 4.—Strawberries on Clato silt loam in association 7. Hills in the background are in association 5.

part of this association is used for homesites, particularly in the vicinity of Kelso.

Blue and ruffed grouse thrive in this association. Hunting is limited. Extreme care should be taken in locating roads and homesites on the association, particularly on Kelso and Rose Valley soils, which are subject to severe erosion and slippage.

Descriptions of the Soils

This section describes the soil series and mapping units in the Cowlitz Area. Each soil series is described briefly in alphabetic order. Following each series description is a fairly detailed description of the most extensive mapping unit in that series. This detailed description is followed by brief descriptions of the rest of the mapping units. Unless it is specifically mentioned otherwise, it is to be assumed that what is stated about the soil series and the first mapping unit holds true for the other mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

Each soil series contains a description of a soil profile, that is, the sequence of layers from the surface downward to the rock or other underlying material. It is brief and in terms familiar to the layman. The first mapping unit of each series contains a detailed description of the soil profile described in the soil series. It is in technical terms and is for scientists, engineers, and others who need to make thorough and precise studies of soils. The descriptions of the rest of the mapping units tell mainly how these units differ from the one described in detail. Unless it is otherwise stated, the colors given in the descriptions are those of a moist soil.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Riverwash, for example, does not belong to a soil series, but nevertheless is listed in alphabetic order along with the soil series.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit, woodland group, and wildlife group in which the mapping unit has been placed. The page for the description of each capability unit can be found by referring to the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual *(10)*.

Bear Prairie Series

The Bear Prairie series consists of well-drained soils that formed in material derived principally from volcanic ash, basalt, and andesite. These soils are on ridgetops and mountainsides. Slopes are 3 to 50 percent. The annual precipitation is 65 to 100 inches. The mean annual air temperature is about 47° F., and the frost-free season is 125 to 140 days. Elevations range from 400 to 2,700 feet.

In a representative profile, the surface layer is silt loam about 19 inches thick. It is very dark brown in the upper part and very dark grayish brown in the lower part. Beneath this layer and extending to a depth of more than 72 inches is dark-brown silt loam. This soil is strongly acid throughout the profile.

All the Bear Prairie soils in the survey area have a surface layer less than 20 inches thick and are thus outside the range for the series. This difference, however, does not alter significantly their usefulness and behavior.

The principal vegetation consists of Douglas-fir, western hemlock, western redcedar, red alder, bigleaf maple, and willow. The understory is vine maple, salal, bracken, red and blue huckleberry, Oregon-grape, salmonberry, and swordfern.

Bear Prairie soils are used mainly for timber production and wildlife habitat.

Bear Prairie silt loam, 30 to 50 percent slopes (BpE).—This soil is on mountainsides. Areas are large and irregular in shape. Slopes generally are 35 to 50 percent.

Representative profile of Bear Prairie silt loam, in a wooded area, about 15 miles north of Stella, about 150 feet north of the road connecting Roads 700 and 821. About 550 feet east and 1,125 feet north of southwest corner of sec. 23, T. 10 N., R. 4 W.:

A11—0 to 5 inches, very dark brown (10YR 2/2) silt loam, dark brown (10YR 3/3) when dry; moderate, very fine, granular structure; soft, very friable, nonsticky, nonplastic; many fine, medium, and coarse roots; about 2 percent concretions 1 to 2 millimeters in diameter; bits of charcoal are evidence of heavy burning; strongly acid; clear, wavy boundary. 3 to 5 inches thick.

A12—5 to 19 inches, very dark grayish-brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) when dry; moderate, fine, granular structure and weak, fine, subangular blocky; slightly hard, friable, slightly sticky, nonplastic; many fine, medium, and coarse roots; common fine tubular pores; about 6 percent concretions 1 to 2 millimeters in diameter; strongly acid; clear, wavy boundary. 8 to 15 inches thick.

B2—19 to 34 inches, dark-brown (10YR 4/3) silt loam, brown (10YR 5/3) when dry; weak, coarse, prismatic structure breaking readily to moderate, medium and fine, subangular blocky; slightly hard, friable, slightly sticky, nonplastic; many fine, medium, and coarse roots; common fine tubular pores; about 4 percent concretions 1 to 2 millimeters in diameter; strongly acid; abrupt, wavy boundary. 9 to 17 inches thick.

C 34 to 77 inches, dark-brown (10YR 4/3) heavy silt loam, brown (10YR 5/3) when dry; weak, coarse, prismatic structure breaking to weak, medium, subangular blocky; hard, firm, sticky, slightly plastic; common fine and very fine roots to a depth of 40 inches, few roots to a depth of 60 inches; common very fine tubular pores; common krotovinas, 1 inch to 3½ inches in diameter; some roots follow old burrows; strongly acid.

The A horizon hues are 10YR and 7.5YR. Value and chroma range from 2 to 3. The C horizon hue ranges from 10YR to 7.5YR, and the chroma and value range from 3 to 4. The B2 and C horizons range from silt loam to light silty clay loam. In some places a few weathered, angular fragments of andesite and basalt are scattered throughout the profile.

Included in mapping are a few rock outcrops, small areas of soils that are gravelly or cobbly throughout, and small areas where the slope is less than 30 percent. Also included are small areas where the slope is more than 50 percent and many areas where most of the surface layer has been removed by erosion.

This soil is moderately permeable and holds more than 10 inches of water that plants can use. Surface runoff is rapid, and the hazard of erosion is severe. Roots penetrate deeply.

This Bear Prairie soil is used for timber production. Capability unit VIe–1; woodland group 3r1; wildlife group 8.

Bear Prairie silt loam, 3 to 15 percent slopes (BpC).—This soil is on broad ridges, hillsides, and toe slopes (fig. 5). In most places slopes are 10 to 12 percent. Areas are irregularly shaped. Small, irregularly shaped areas are mapped with Loper soils.

Included in mapping are small areas of soils that are gravelly or cobbly throughout, small areas that have a few rock outcrops, and some small areas where the slope is less than 3 percent or more than 15 percent.

Surface runoff is slow to medium, and the hazard of erosion is slight to moderate. This soil is used for timber production. Capability unit IIIe–3; woodland group 3o1; wildlife group 8.

Bear Prairie silt loam, 15 to 30 percent slopes (BpD).—This soil is on mountainsides and hillsides. Its surface layer is 11 to 22 inches thick.

Included in mapping are small areas where erosion has removed some or all of the original surface layer, small areas of soils that are gravelly or cobbly throughout, and some small areas where the slope is less than 15 percent or more than 30 percent.

Surface runoff is medium to rapid, and the hazard of erosion is moderate to severe.

This soil is used for timber production. Capability group IVe–2; woodland group 3o1; wildlife group 8.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Mapping unit	Acres	Percent
Bear Prairie silt loam, 3 to 15 percent slopes	1, 825	0. 48
Bear Prairie silt loam, 15 to 30 percent slopes	3, 133	. 83
Bear Prairie silt loam, 15 to 30 percent slopes, eroded	319	. 08
Bear Prairie silt loam, 30 to 50 percent slopes	4, 388	1. 16
Camas cobbly loam	466	. 12
Caples silt loam	7, 498	1. 99
Caples silty clay loam	5, 139	1. 36
Cinebar gravelly silt loam, 0 to 8 percent slopes	228	. 06
Cinebar gravelly silt loam, 8 to 20 percent slopes	1, 007	. 27
Cinebar gravelly silt loam, 20 to 30 percent slopes	9, 002	2. 38
Cinebar gravelly silt loam, 30 to 50 percent slopes	17, 268	4. 57
Cinebar loam, 0 to 8 percent slopes	2, 620	. 69
Cinebar silt loam, 8 to 20 percent slopes	860	. 23
Cinebar silt loam, 20 to 30 percent slopes	2, 316	. 61
Cispus gravelly sandy loam, 8 to 20 percent slopes	573	. 16
Cispus gravelly sandy loam, 20 to 60 percent slopes	978	. 26
Clato silt loam	6, 557	1. 74
Clato silt loam, coarse variant	965	. 26
Coweeman silt loam, 5 to 15 percent slopes	755	. 20
Coweeman silty clay loam, 8 to 30 percent slopes	1, 332	. 35
Coweeman silty clay loam, dark variant, 0 to 4 percent slopes	709	. 19
Gee silt loam, 0 to 8 percent slopes	1, 221	. 32
Gee silt loam, 8 to 15 percent slopes	951	. 25
Gee silt loam, 15 to 40 percent slopes	827	. 22
Germany silt loam, 0 to 8 percent slopes	2, 491	. 66
Germany silt loam, 8 to 20 percent slopes	6, 239	1. 65
Germany silt loam, 20 to 30 percent slopes	12, 676	3. 36
Germany cobbly silt loam, 20 to 30 percent slopes	695	. 18
Germany silt loam, 30 to 50 percent slopes	4, 778	1. 27
Germany cobbly silt loam, 30 to 50 percent slopes	4, 073	1. 08
Godfrey silt loam	1, 992	. 53
Godfrey silty clay loam	666	. 18
Hillsboro silt loam, 0 to 40 percent slopes	409	. 11
Kalama gravelly loam, 0 to 8 percent slopes	196	. 05
Kalama gravelly loam, 8 to 15 percent slopes	373	. 10
Kalama gravelly loam, 15 to 30 percent slopes	1, 127	. 30
Kalama gravelly loam, 30 to 60 percent slopes	680	. 18
Kelso silt loam, 0 to 8 percent slopes	2, 303	. 61
Kelso silt loam, 8 to 15 percent slopes	1, 866	. 49
Kelso silt loam, 15 to 30 percent slopes	2, 304	. 61
Kelso silt loam, 30 to 50 percent slopes	793	. 21
Loper-Bear Prairie complex, 3 to 15 percent slopes	2, 886	. 76
Loper-Bear Prairie complex, 15 to 30 percent slopes	4, 068	1. 08
Loper-Bear Prairie complex, 8 to 30 percent slopes, eroded	1, 361	. 37
Loper-Bear Prairie complex, 30 to 50 percent slopes	10, 285	2. 72
Made land	483	. 13
McBee silty clay	353	. 09
Mart silt loam, 0 to 8 percent slopes	491	. 13
Mart silt loam, 8 to 20 percent slopes	3, 334	. 88
Mart silt loam, 20 to 30 percent slopes	4, 709	1. 25
Mart silt loam, 30 to 50 percent slopes	2, 244	0. 59
Minniece silt loam, 0 to 8 percent slopes	2, 059	. 55
Minniece silt loam, 8 to 25 percent slopes	340	. 09
Minniece silt loam, loamy variant, 0 to 3 percent slopes	639	. 17
Newberg fine sandy loam	5, 459	1. 45
Newberg silt loam, silty variant	1, 364	. 36
Olequa silt loam, 0 to 8 percent slopes	2, 839	. 75
Olequa silt loam, 8 to 20 percent slopes	5, 223	1. 39
Olequa silt loam, 20 to 30 percent slopes	15, 844	4. 20
Olequa silt loam, 30 to 50 percent slopes	7, 806	2. 07
Olequa silt loam, moderately well drained variant, 3 to 8 percent slopes	718	. 19
Olequa silt loam, moderately well drained variant, 8 to 15 percent slopes	603	. 16
Olympic cobbly silt loam, 0 to 20 percent slopes	1, 230	. 32
Olympic gravelly silt loam, 2 to 8 percent slopes	821	. 22
Olympic gravelly silt loam, 8 to 20 percent slopes	6, 055	1. 60
Olympic gravelly silt loam, 20 to 30 percent slopes	19, 069	5. 05
Olympic gravelly silt loam, 30 to 50 percent slopes	23, 885	6. 32
Olympic silt loam, 8 to 20 percent slopes	23, 668	6. 22
Olympic silt loam, 2 to 8 percent slopes	8, 474	2. 24
Olympic silt loam, 20 to 30 percent slopes	34, 454	9. 12
Olympic silt loam, 30 to 50 percent slopes	12, 285	3. 25
Pilchuck loamy fine sand, 0 to 8 percent slopes	4, 112	1. 08
Riverwash	1, 065	. 28
Rock land	3, 990	1. 07
Rose Valley silt loam, 0 to 8 percent slopes	1, 174	. 31
Rose Valley silt loam, 8 to 15 percent slopes	983	. 26
Rose Valley silt loam, 15 to 30 percent slopes	455	. 12
Rose Valley silt loam, thin surface variant, 0 to 6 percent slopes	546	. 14
Sara silt loam, 0 to 8 percent slopes	1, 070	. 29
Sara silt loam, 8 to 15 percent slopes	1, 153	. 30
Sara silt loam, 15 to 30 percent slopes	1, 664	. 44
Sara silty clay loam, 0 to 8 percent slopes	1, 288	. 34
Sauvola loam, 0 to 8 percent slopes	513	. 14
Sauvola loam, 8 to 15 percent slopes	520	. 14
Sauvola loam, 15 to 30 percent slopes	1, 034	. 27
Seaquest silt loam, 0 to 8 percent slopes	5, 208	1. 38
Seaquest silt loam, 8 to 20 percent slopes	6, 164	1. 63
Seaquest silt loam, 20 to 30 percent slopes	3, 978	1. 05
Semiahmoo peat	1, 310	. 35
Sifton gravelly loam, 0 to 8 percent slopes	716	. 19
Snohomish silty clay loam	1, 445	. 38
Speelyai gravelly loamy sand, 0 to 8 percent slopes	1, 534	. 41
Speelyai gravelly loamy sand, 15 to 60 percent slopes	208	. 06
Toutle fine sandy loam, 0 to 8 percent slopes	2, 870	. 76
Toutle fine sandy loam, 15 to 45 percent slopes	255	. 07
Toutle gravelly loamy sand, 0 to 8 percent slopes	1, 169	. 31
Toutle loamy sand, 0 to 8 percent slopes	1, 781	. 46
Toutle loamy sand, 8 to 40 percent slopes	412	. 11
Vader loam, 8 to 30 percent slopes	356	. 10
Vader loam, 30 to 50 percent slopes	2, 949	. 78
Water	9, 911	2. 71
Total	377, 480	100. 0

Figure 5.—An area of Bear Prairie silt loam, 3 to 15 percent slopes.

Bear Prairie silt loam, 15 to 30 percent slopes, eroded (BpD2).—This soil is on mountainsides and hillsides. From 50 to 75 percent of the surface layer has been lost through erosion. The present surface layer is only about 3 to 11 inches thick.

Included in mapping are small areas that are only slightly eroded, small areas where the slope is more than 30 percent or less than 15 percent, and small areas of soils that are gravelly or cobbly throughout. Also included are small areas where erosion has removed the entire original surface layer and exposed the subsoil.

Surface runoff is medium to rapid, and the hazard of erosion is moderate to severe.

This soil is used to produce timber. Capability group IVe–2; woodland group 3d4; wildlife group 8.

Camas Series

The Camas series consists of excessively drained soils that formed in recent alluvium. These soils are on narrow flood plains. Slopes are 0 to 3 percent. The annual precipitation is 45 to 70 inches. The mean annual air temperature is about 51° F., and the frost-free season is 165 to 180 days. Elevations range from 50 to 500 feet.

In a representative profile, the soil is very dark brown cobbly loam to a depth of about 22 inches. Between depths of 22 and 60 inches is dark-brown very cobbly loamy sand. This soil is medium acid throughout the profile.

The principal vegetation is bigleaf maple, red alder, western redcedar, Douglas-fir, and hazel. Cleared areas are used mainly for pasture.

Camas cobbly loam (Ca).—This soil is on narrow, winding flood plains near streams. In most places slopes are 2 to 3 percent.

Representative profile of Camas cobbly loam, in a pasture, approximately 3.6 miles north of Kelso and 13 miles northwest of Longview. About 60 feet west of Germany Creek Road in the NW¼SE¼NW¼SE¼ sec. 26, T. 9 N., R. 4 W.:

A1—0 to 4 inches, very dark brown (10YR 2/2) cobbly loam, very dark grayish brown (10YR 3/2) when dry; moderate, fine, granular structure; slightly hard, very friable, slightly sticky, slightly plastic; many fine roots; medium acid; clear, smooth boundary. 2 to 5 inches thick.

AC—4 to 22 inches, very dark brown (10YR 2/2) cobbly loam, dark brown (10YR 3/3) when dry; moderate, very fine, subangular blocky structure; slightly hard, nonsticky, nonplastic; many fine roots to a depth of 10 inches, common fine roots to a depth of 22 inches; medium acid; clear, smooth boundary. 14 to 21 inches thick.

C—22 to 60 inches, dark-brown (10YR 3/3) very cobbly loamy sand, dark brown (10YR 4/3) when dry; single grain; loose, nonsticky, nonplastic; few fine and very fine roots; medium acid.

Depth to the very cobbly loamy sand is 10 to 30 inches. In places color values of the A horizon range from 2 to 3 and chromas from 2 to 3. Values of the C horizon range from 3 to 4 and chromas from 3 to 4. A few stones as much as 16 inches in diameter occur throughout the profile.

Included in mapping are small areas of soil relatively free of cobblestones, stones, and gravel to a depth of more than 40 inches.

This Camas soil is very rapidly permeable. It holds about 3 inches of water that plants can use. Surface runoff is very slow. The erosion hazard from floodwater is moderate.

This soil is used mainly for pasture. It is also suited to wood crops. Capability unit VIs–2; woodland group 3f1; wildlife group 9.

Caples Series

The Caples series consists of somewhat poorly drained and poorly drained soils that formed in alluvium on flood plains of the Columbia and Cowlitz Rivers. Slopes are 0 to 3 percent. Annual precipitation is 38 to 50 inches. Mean annual air temperature is about 52° F., and the frost-free season is 165 to 195 days. Elevations are less than 25 feet.

In a representative profile, the surface layer, to a depth of 9 inches, is mottled dark-brown silt loam or silty clay loam. The subsoil and substratum are mottled gray, grayish-brown, and dark-gray silty clay loam. The soil is medium acid throughout the profile.

Vegetation is mostly black cottonwood, reed canarygrass, and sedges. Drained areas are used for row crops, specialty crops, hay, and pasture.

Caples silt loam (Ce).—This soil occupies broad, irregularly shaped areas on the flood plains of the Columbia and Cowlitz Rivers. In most places it is 1 to 2 feet lower in elevation than the associated Newberg silt loam, silty variant. Slopes are 0 to 3 percent. Large areas of this soil are at Willow Grove and Woodland.

Representative profile of Caples silt loam, in pasture, approximately 5 miles west of Longview in Willow Grove, 500 feet north of Willow Grove Road and 170 feet west of silo, 1,500 feet west and 1,060 feet north of the southeast corner of sec. 16, T. 8 N., R. 3 W.:

Ap1—0 to 4 inches, dark-brown (10YR 3/3) silt loam, grayish brown (10YR 5/2) when dry; moderate, fine, granular structure and moderate, fine, subangular blocky; hard, friable (subangular blocks are firm), slightly sticky, slightly plastic; many fine and medium roots and few coarse roots; many worm casts; medium acid; abrupt, smooth boundary. 3 to 6 inches thick.

Ap2—4 to 9 inches, dark-brown (10YR 3/3) light silty clay loam, grayish brown (10YR 5/2) when dry; many, moderate, distinct, strong-brown (7.5YR 5/8) and gray (10YR 6/1) mottles, strong brown (7.5YR 5/8) and light brownish gray (10YR 6/2) when dry; strong, fine, subangular blocky structure and moderate, fine, granular; slightly hard, friable, slightly sticky, slightly plastic; many fine and medium roots and few coarse roots; few medium and coarse tubular pores; medium acid; abrupt, smooth boundary. 4 to 6 inches thick.

B21g—9 to 25 inches, gray (5Y 5/1) heavy silty clay loam, gray (5Y 6/1) when dry; many, fine, prominent, yellowish-red (5Y 5/6) and dark reddish-brown (2.5YR 3/4) mottles, strong brown (7.5YR 5/6) and dark reddish brown (2.5YR 3/4) when dry; moderate, coarse, prismatic structure and moderate, medium and fine, subangular blocky; hard, firm, slightly sticky, slightly plastic; many fine and medium roots; common medium tubular pores; medium acid; abrupt, smooth boundary, 4 to 6 inches thick.

B22g—25 to 39 inches, grayish-brown (2.5YR 5/2) heavy silty clay loam, light brownish gray (2.5Y 6/2) when dry; many, medium, prominent, reddish-brown (5YR 4/4) and strong-brown (7.5YR 5/6) mottles, yellowish red (5YR 5/6) and reddish yellow (5YR 6/6) when dry; moderate, coarse, prismatic structure and weak, thick, platy; very hard, firm, sticky, plastic; common fine and medium roots to a depth of 36 inches and a few fine roots between depths of 36 and 39 inches; few medium, fine, and coarse tubular pores; medium acid; abrupt, smooth boundary, 12 to 15 inches thick.

C1g—39 to 44 inches, dark-gray (5YR 4/1 silty clay loam, gray (5YR 6/1) when dry; few, fine prominent, dark brown (7.5YR 4/4) mottles along old root channels, reddish yellow (7.5YR 6/8) when dry; massive; very hard, firm, sticky, plastic; few fine roots; common coarse tubular pores; medium acid; clear, smooth boundary. 4 to 7 inches thick.

C2g—44 to 72 inches, gray (N 5/0) silty clay loam, gray (5Y 6/1) when dry; few, fine, prominent, dark-brown (7.5YR 4/4) mottles along old root channels, strong brown (7.5YR 5/8) when dry; massive; very hard, firm, very sticky, plastic; few fine roots; common coarse tubular pores; medium acid.

In places the A horizon is fine sandy loam or silty clay loam. In places it is mottled. It ranges in value from 2 to 3 and in chroma from 1 to 3. The B2g horizon ranges from 4 to 5 in value and from 1 to 2 in chroma, and is 10YR, 2.5Y, or 5Y in hue. The C horizon, in places, has lenses of sandy loam, loamy sand, or sand ½ inch to 3 inches thick. Sandy loam or loamy sand is below a depth of 40 inches in some areas.

Included in mapping are small areas where the surface layer is fine sandy loam and a few small areas of poorly drained soils that have a surface layer of silty clay loam.

This Caples soil is somewhat poorly drained, is slowly permeable, and holds about 11 inches of water that plants can use. Surface runoff is very slow, and the hazard of erosion is slight. A seasonal high water table at a depth of 1 to 3 feet restricts development of deep-rooted crops. The soil is subject to occasional flooding. Unless drained, it is suited mainly to water-tolerant plants. If drained, it is suited to pasture (fig. 6), hay,

Figure 6.—Pasture on Caples silt loam.

small grain, peppermint, peas, bulbs, corn, cabbage, carrots, and potatoes. Capability unit IIw–1; wildlife group 1; not placed in a woodland group.

Caples silty clay loam (Ch).—This soil is similar to Caples silt loam, but it is poorly drained and is silty clay loam throughout. It is about 1 foot lower in elevation than Caples silt loam. Large areas of this soil are near Willow Grove and Woodland.

Included in mapping are small areas of soils that have layers of fine sandy loam and loamy fine sand below a depth of 40 inches and small areas where there are buried horizons of black or very dark grayish-brown and of grayish rock flour of silt or silt loam texture.

Unless drained, this soil is suited only to water-tolerant plants. If drained, it is suited to pasture, hay, small grain, peppermint, peas, bulbs, corn, cabbage, carrots, and potatoes. If this soil is to be used for crops, a more intensive drainage system is required than on Caples silt loam. Capability group IIw–1; wildlife group 1; not placed in a woodland group.

Cinebar Series

The Cinebar series consists of well-drained soils that formed in silty wind-laid deposits and volcanic ash on the uplands. Slopes are 0 to 50 percent. The annual precipitation is 70 to 120 inches. The mean annual air temperature is about 48° F., and the frost-free season is 120 to 140 days. Elevations range from 300 to 3,000 feet.

In a representative profile, the soil is very dark brown to dark-brown gravelly silt loam to a depth of 42 inches. Some areas are nearly gravel free, and some are cobbly. Between depths of 42 and 60 inches or more is dark-brown or dark yellowish-brown silt loam. The soil is medium acid to neutral throughout the profile.

Vegetation is mainly Douglas-fir, red alder, and bigleaf maple. This soil is used mainly for timber, pasture, and hay.

Cinebar gravelly silt loam, 30 to 50 percent slopes (CoE).—This soil is on mountainsides. In most places it occurs as large, long tracts in association with Cispus soils. Slopes are dominantly 35 to 45 percent.

Representative profile of Cinebar gravelly silt loam, in wooded area approximately 13 miles northeast of Woodland and about 1,440 feet northeast of the Lewis River Road from a point 0.15 mile east of Wilkinson Road. About 1,445 feet north and 900 feet west of the southeast corner of sec. 13, T. 6 N., R. 2 E.:

A11—0 to 4 inches, very dark brown (10YR 2/2) gravelly silt loam, very dark grayish brown (10YR 3/2) when dry; moderate, fine, granular structure; soft, very friable, nonsticky, nonplastic; many fine and medium roots; many fine interstitial pores; common fine shot; medium acid; clear, wavy boundary. 3 to 5 inches thick.

A12—4 to 10 inches, very dark grayish-brown (10YR 3/2) gravelly silt loam, dark grayish brown (10YR 4/2) when dry; moderate, fine, granular structure; soft, very friable, nonsticky, nonplastic; many fine and medium roots; many fine interstitial pores; many fine shot; medium acid; clear, wavy boundary. 6 to 10 inches thick.

A3—10 to 18 inches, dark-brown (10YR 3/3) gravelly silt loam, brown (10YR 5/3) when dry; moderate, fine, granular structure; soft, very friable, nonsticky, nonplastic; many fine and medium roots; many fine interstitial pores; many fine shot; medium acid; gradual, wavy boundary. 7 to 10 inches thick.

B21—18 to 42 inches, dark-brown (10YR 4/3) gravelly silt loam, light yellowish brown (10YR 6/4) when dry; moderate, fine, granular structure and weak, fine, subangular blocky; slightly hard, friable, slightly sticky, nonplastic; common fine and medium roots; few fine and medium tubular pores; common fine shot; slightly acid; gradual, wavy boundary. 22 to 27 inches thick.

B22—42 to 52 inches, dark-brown (10YR 4/3) silt loam, light yellowish brown (10YR 6/4) when dry; weak, fine and medium, subangular blocky structure; hard, firm (some brittleness), nonsticky, nonplastic; few fine roots; many fine and few medium tubular pores; common fine shot; slightly acid; gradual, wavy boundary. 8 to 13 inches thick.

C—52 to 75 inches, dark yellowish-brown (10YR 4/4) silt loam, light yellowish brown (10YR 6/4) when dry; weak, medium, subangular blocky structure to massive; slightly hard, firm, nonsticky, nonplastic; few fine roots in upper 10 inches, none below; many fine and few medium tubular pores; few fine shot; neutral.

The A1 horizon ranges in value from 2 to 3 and in chroma from 1 to 3. The B horizon ranges in value and chroma from 3 to 5. Variable amounts of pumice and shot are scattered throughout the profile, and in places shot makes up as much as 50 percent of the lower part of the A horizon. Soil reaction ranges from strongly acid to neutral and pH increases with depth. In places the surface layer is loam to a depth of about 30 inches. In places the upper part of the subsoil is sandy loam. Below a depth of 50 inches is loamy coarse sand.

Included in mapping are small areas of cobbly soils, of soils that contain very little gravel, and of soils that have a loose sandy subsoil or a very firm sandy subsoil. Also included are outcrops of basalt and andesite and small areas where the slopes are less than 30 percent or more than 50 percent.

This Cinebar soil is moderately permeable and holds about 8 inches of water that plants can use. Surface runoff is rapid, and the hazard of erosion is severe.

This soil is used mainly for timber production and wildlife habitat. Capability group VIe–1; woodland group 2r1; wildlife group 7.

Cinebar silt loam, 8 to 20 percent slopes (CnC).—This soil is similar to Cinebar gravelly silt loam, 30 to 50 percent slopes, but its surface layer is not gravelly, and its subsoil is slightly more brittle and firm. It is near the edges of broad ridgetops and hillsides. There are very few rock outcrops.

Included in mapping are areas of soils that have a loose sandy subsoil and soils that have a very firm sandy subsoil.

Surface runoff is medium, and the hazard of erosion is moderate. The soil holds more than 10 inches of water that plants can use.

This soil is used mainly for woodland, but small acreages are used for hay, pasture, and small grain. Capability group IVe–7; woodland group 2o2; wildlife group 5.

Cinebar silt loam, 20 to 30 percent slopes (CnD).—This soil is on mountainsides. It is similar to Cinebar gravelly silt loam, 30 to 50 percent slopes, but the surface layer and upper subsoil are not gravelly.

Included in mapping are common rock outcrops and small areas of soils that have a loose sandy subsoil and soils that have a very firm sandy subsoil.

Surface runoff is medium to rapid, and the hazard of erosion is moderate to severe. The soil holds more than 10 inches of water that plants can use.

This soil is used mainly for woodland. Only a small acreage is cleared for farming. Capability group IVe–7; woodland group 2o2; wildlife group 7.

Cinebar gravelly silt loam, 0 to 8 percent slopes (CoB).—This soil is on broad ridgetops and benches below the steep hillsides. It resembles Cinebar gravelly silt loam, 30 to 50 percent slopes, but the subsoil is slightly more brittle and firm, and there are very few basalt and andesite rock outcrops.

Included in mapping are small areas of soils that have a loose sandy subsoil and soils that have a very firm sandy subsoil.

Surface runoff is slow, and the hazard of erosion is slight.

This soil is used mainly for woodland. Small acreages are used for hay, pasture, and small grain. Capability group IVe–7; woodland group 2o2; wildlife group 5.

Cinebar gravelly silt loam, 8 to 20 percent slopes (CoC).—This soil is near the edges of broad ridgetops and on hillsides. It is similar to Cinebar gravelly silt loam, 30 to 50 percent slopes, but its subsoil is slightly more brittle and firm.

Included in mapping are small areas of soils that have a loose sandy subsoil, soils that have a very firm sandy subsoil, and soils that have a cobbly surface layer. Also included are a few rock outcrops.

Surface runoff is medium, and the hazard of erosion is moderate.

This soil is used principally for woodland, but small acreages are used for hay, pasture, and small grain. Capability group IVe–7; woodland group 2o1; wildlife group 5.

Cinebar gravelly silt loam, 20 to 30 percent slopes (CoD).—This soil is on mountainsides, and rock outcrops are common.

Included in mapping are small areas of cobbly soils, of soils that have a loose sandy subsoil, and of soils that have a very firm sandy subsoil.

Surface runoff is medium to rapid, and the hazard of erosion is moderate to severe.

Only a small acreage is cleared for farming. Woodland is the principal use. Capability group IVe–7; woodland group 2o2; wildlife group 7.

Cinebar loam, 0 to 8 percent slopes (CmB).—This soil is similar to Cinebar gravelly silt loam, 30 to 50 percent slopes, but it is loam that is less than 10 percent gravel to a depth of about 30 inches, the upper subsoil is sandy loam, and the lower subsoil is loamy coarse sand. This soil occurs as large tracts on terraces adjacent to the upper Lewis River. In most places slopes are 2 to 3 percent.

Included in mapping are small areas of soils that have a silt loam surface layer and soils that have a very gravelly coarse sand or very cobbly coarse sand subsoil. Also included are small areas where the surface layer is black, areas where the soil has cobblestones throughout the profile, and areas where the slope is more than 8 percent.

Surface runoff is slow, and the hazard of erosion is slight.

This soil is used for timber production, hay, pasture, and small grain. Capability group IVe–7; woodland group 2o2; wildlife group 5.

Cispus Series

The Cispus series consists of somewhat excessively drained soils that formed in pumice and andesite mudflow material. Slopes are 8 to 60 percent. The annual precipitation is 100 to 120 inches. The mean annual air temperature is about 48° F., and the frost-free season is 120 to 140 days. Elevations range from 500 to 1,500 feet.

In a representative profile, the surface layer, to a depth of 4 inches, is black gravelly sandy loam. The substratum is dark-brown, and very dark grayish-brown gravelly loamy sand to a depth of 60 inches or more. The soil is mainly slightly acid throughout the profile.

Vegetation is Douglas-fir, bigleaf maple, vine maple, bitter cherry, and red adler and an understory of salal, swordfern, hazel, and dogwood.

Cispus soils are used mainly for timber.

Cispus gravelly sandy loam, 20 to 60 percent slopes (CsE).—This soil occurs as large tracts on the uplands in the upper Lewis River drainage system. The slopes are long and dominantly 40 to 50 percent.

Representative profile of Cispus gravelly sandy loam, in woodland, in a pit approximately 27 miles east of Woodland, 2.05 miles east of Cougar, and 300 feet north of billboard on north side of curve on the Lewis River Road. About 1,800 feet south and 250 feet east of the northwest corner of sec. 25, T. 7 N., R. 4 E.:

A1—0 to 4 inches black (10YR 2/1) gravelly sandy loam, very dark grayish brown (10 YR 3/2) when dry; single grain; loose, nonsticky, nonplastic; many fine, medium, and coarse roots; about 16 percent gravel, mostly very fine; slightly acid; abrupt, wavy boundary. 3 to 6 inches thick.

AC—4 to 9 inches, dark-brown (10YR 3/3) gravelly loamy sand, brown (10YR 5/3) when dry; single grain; loose, nonsticky, nonplastic; many fine, medium, and coarse roots; about 15 percent gravel, mostly very fine; neutral; abrupt, wavy boundary. 3 to 5 inches thick.

C1—9 to 24 inches, dark grayish-brown (2.5Y 4/2) and very dark grayish-brown (2.5Y 3/2) gravelly loamy sand, light brownish gray (2.5Y 6/2) when dry; single grain; loose, nonsticky, nonplastic; many fine, medium, and coarse roots; about 20 percent gravel; slightly acid; gradual, wavy boundary. 13 to 21 inches thick.

C2—24 to 42 inches, very dark grayish-brown (10YR 3/2) and dark-brown (10YR 4/3) gravelly loamy sand, light brownish gray (10YR 6/2) when dry; single grain; loose, nonsticky, nonplastic; many fine, medium, and coarse roots to a depth of 31 inches, common fine and medium and few coarse roots to a depth of 42 inches; about 45 percent gravel; slightly acid; clear, wavy boundary. 17 to 25 inches thick.

C3—42 to 60 inches, dark-brown (10YR 4/3) gravelly loamy sand, very pale brown (10YR 7/3) when dry; single grain; loose, nonsticky, nonplastic; few fine roots to a depth of 51 inches; about 60 percent of volume is gravel and cobblestones; slightly acid.

The A1 horizon ranges from black to dark brown and from sandy loam or gravelly sandy loam to loamy sand. The gravel content of the C horizon ranges from 20 to 60 percent. Stoniness increases with increasing depth. The soil at the base of steep slopes is primarily poorly sorted sands, gravel, cobblestones, and stones.

Included in mapping are small areas where the slope is less than 20 percent.

This Cispus soil is very rapidly permeable, and roots penetrate deeply. The soil holds about 4 inches of water that plants can use. Surface runoff is medium, and the erosion hazard is severe.

The principal crop is Douglas-fir. Capability group VIe–3; woodland group 3s1; wildlife group 9.

Cipus gravelly sandy loam, 8 to 20 percent slopes (CsC).—This soil occurs as moderately small tracts on mountain toe slopes. Slopes are dominantly 12 to 15 percent.

Included in mapping are small areas where the slope is more than 20 percent and many areas where it is less than 8 percent.

Surface runoff is slow, and the hazard of erosion is moderate.

This soil is used for timber. Capability group IVe–9; woodland group 3s1; wildlife group 9.

Clato Series

The Clato series consists of well-drained soils that formed in sediment on flood plains of the Columbia, Cowlitz, Coweman, and Lewis Rivers and some of the minor streams. Slopes are 0 to 3 percent. The annual precipitation is 40 to 60 inches. The mean annual air temperature is about 52°F., and the frost-free season is 160 to 180 days. Elevations range from 30 to 300 feet.

In a representative profile, the soil to a depth of more than 60 inches is dark yellowish-brown to dark-brown silt loam and heavy silt loam. Reaction is medium acid throughout the profile.

Vegetation is principally red alder, bigleaf maple, Douglas-fir, and western redcedar.

Most areas have been cleared of timber and are used mainly for hay, pasture, truck crops, berries, and small grain.

Clato silt loam (Ct).—This nearly level to undulating soil is on flood plains and is commonly dissected by old

stream channels. Slopes are 0 to 3 percent. Tracts are long and moderately narrow and parallel the drainageways.

Representative profile of Clato silt loam, in a pasture, approximately 3 miles west of Castle Rock and 180 feet northwest of the intersection of Hazel Dell Road and Delameter Road, 940 feet west and 990 feet south of the northeast corner of sec. 17, T. 9 N., R. 2 W.:

Ap—0 to 11 inches, dark yellowish-brown (10YR 3/4) silt loam, yellowish brown (10YR 5/4) when dry; strong, medium, subangular blocky structure; hard, friable, slightly sticky, slightly plastic; many fine and medium roots; many fine tubular pores; medium acid; clear, smooth boundary. 9 to 12 inches thick.

AC—11 to 19 inches, dark-brown (10YR 3/3) silt loam, brown (10YR 5/3) when dry; strong, fine, subangular blocky structure; hard, very friable, nonsticky, slightly plastic; many fine and medium roots in the upper 3 inches and common fine roots in the lower 5 inches; many fine interstitial pores; medium acid; clear, smooth boundary. 7 to 10 inches thick.

C1—19 to 42 inches, dark yellowish-brown (10YR 3/4) heavy silt loam, yellowish brown (10YR 5/4) when dry; moderate, medium, prismatic structure and moderate, fine, subangular blocky; hard, friable, slightly sticky, slightly plastic; common fine roots; many fine and few coarse tubular pores; medium acid; diffuse, smooth boundary. 20 to 23 inches thick.

C2—42 to 69 inches, dark yellowish-brown (10YR 3/3) heavy silt loam, brown (10YR 5/3) when dry; moderate, medium, subangular blocky structure; hard, friable, slightly sticky, slightly plastic; common fine roots in the upper 6 inches and few fine roots in the lower 21 inches; many fine and few coarse tubular pores; medium acid; gradual, smooth boundary. 23 to 30 inches thick.

In places the A horizon is loam. Colors range from 2 to 3 in value and from 2 to 4 in chroma. In places a sandy stratum is present in the C horizon, generally at a depth below 30 inches. In some places the C horizon has a laminar structure.

Included in mapping are small areas of mottled, somewhat poorly drained and poorly drained sandy soils.

This Clato soil is moderately permeable and holds more than 10 inches of water that plants can use. Surface runoff is very slow, and there is little or no hazard of erosion. In a few places the soil is subject to overflow.

Hay, pasture, cane fruit, strawberries, corn, truck crops (fig. 7), and small grain are grown on this soil. Capability unit I–1; wildlife group 2; not in a woodland group.

Clato Series, Coarse Variant

The Clato series, coarse variant, consists of well-drained soils that formed in recent alluvium washed from basic rocks. Slopes are 0 to 3 percent. The annual precipitation is 50 to 60 inches. The mean annual air temperature is about 51°F., and the frost-free season is 160 to 180 days. Elevations range from 50 to 300 feet.

In a representative profile, the upper 25 inches is dark-brown silt loam and loam. Below this is dark-brown gravelly fine sandy loam to a depth of about 32 inches and dark-brown gravelly coarse sand to a depth of more than 60 inches. The soil is strongly acid to medium acid throughout the profile.

Vegetation is Douglas-fir, western redcedar, black cottonwood, western hemlock, and bigleaf maple and an understory of salmonberry, elderberry, and bracken.

Clato series, coarse variant, is used for hay, pasture, and woodland.

Clato silt loam, coarse variant (Cv).—This soil is on narrow flood plains of streams in the western part of the Cowlitz area. In most places, slopes are 2 to 3 percent.

Representative profile of Clato silt loam, coarse variant, in a pasture, approximately 13 miles northwest of Longview, 3.75 miles north of Stella, and 80 feet west of Germany Creek Road. About 1,500 feet west and 2,500 feet south of the northeast corner of sec. 26, T. 9 N., R 4 W.:

A11—0 to 4 inches, dark-brown (7.5YR 3/4) silt loam, brown (7.5YR 5/4) when dry; strong, fine, subangular blocky structure and strong, fine, granular; hard, friable, nonsticky, slightly plastic; many fine, medium, and coarse roots; few pebbles; strongly acid; abrupt, wavy boundary. 3 to 6 inches thick.

A12—4 to 9 inches, dark-brown (7.5YR 3/4) loam, brown (7.5YR 5/4) when dry; moderate, fine and medium, subangular blocky structure; hard, friable, nonsticky, slightly plastic; many fine, medium, and coarse roots; few fine tubular and many fine interstitial pores; few pebbles; strongly acid; clear, smooth boundary. 4 to 7 inches thick.

B2—9 to 25 inches, dark-brown (7.5YR 3/4) loam, brown (7.5YR 5/4) when dry; weak, medium, prismatic structure; slightly hard, very friable, nonsticky, slightly plastic; common fine and medium roots to a depth of 25 inches, few fine roots between depths of 25 and 34 inches; few fine tubular and many fine interstitial pores; few pebbles; medium acid; clear, wavy boundary. 14 to 18 inches thick.

IIC1—25 to 32 inches, dark-brown (10YR 4/3) gravelly fine sandy loam, yellowish brown (10YR 5/4) when dry; massive; soft to slightly hard, very friable, nonsticky, nonplastic; few fine roots; medium acid; clear, wavy boundary. 5 to 12 inches thick.

IIIC2—32 to 60 inches, dark-brown (10YR 4/3) very gravelly coarse sand, yellowish brown (10YR 5/4) when dry; single grain; loose; few fine roots to a depth of 52 inches; medium acid.

The texture of the A1 horizon ranges from loam to silt loam. The hue is 10YR and 7.5YR, value is 2 or 3, and chroma ranges from 2 to 4. Texture of the B2 horizon ranges from loam to silt loam. The value is 3 or 4, and chroma is 3 or 4, and hue is 10YR and 7.5YR. Depth to very gravelly coarse sand ranges from 20 to 36 inches.

Included in mapping are small areas of shallow, somewhat excessively drained soils that have a cobbly loam surface layer, areas of soils that have fine sandy loam surface layer and subsurface layer, and areas of soils that have a gravelly loam surface layer.

This Clato soil is moderately permeable to a depth of 20 to 36 inches and is very rapidly permeable below. It holds about 7 inches of water that plants can use. Surface runoff is slow. There is a slight to moderate hazard of erosion from floodwater. In some areas there is a seasonal high water table at a depth of more than 4 feet.

Pasture plants and hay are the principal crops. Row crops can be grown, but cultivated soils should be protected from eroding floodwater. Capability unit IIw–2; woodland group 3d3; wildlife group 2.

Coweeman Series

The Coweeman series consists of somewhat poorly drained soils that formed in old sediment from basic volcanic rocks. Slopes are 5 to 30 percent. The annual

Figure 7.—**Carrot crop on Clato silt loam. Carrots are machine dug, handpicked, topped, washed, graded and packaged for market on farm near Woodland.**

precipitation is 45 to 65 inches. The mean annual air temperature is about 51°F., and the frost-free season is 165 to 180 days. Elevations range from 250 to 700 feet.

In a representative profile, the surface layer is dark grayish-brown silty clay loam about 7 inches thick. The subsoil is mainly light brownish-gray to gray clay. It extends to a depth of more than 60 inches. The soil is strongly acid to medium acid. It becomes less acid with increasing depth. In places the surface layer is silt loam.

Vegetation is Douglas-fir, red alder, western redcedar, western hemlock, white fir, Oregon ash, bitter cherry, and cascara and an understroy of salal, sedges, hazel, swordfern, bracken, Oregon-grape, and vine maple.

Coweeman soils are used principally for timber. Some areas have been cleared and are used for hay and pasture.

Coweeman silty clay loam, 8 to 30 percent slopes (CxD).—This soil is in small tracts.

Representative profile of Coweeman silty clay loam, in woodland, approximately 6 miles southeast of Kelso, about 1 mile south of the junction of Rose Valley and Fish Pond Roads, and 50 feet northwest of Fish Pond Road. 1,625 feet east and 565 feet north of southwest corner of sec. 17, T. 7 N., R. 1 W.:

A1—0 to 7 inches, dark grayish-brown (10YR 4/2) silty clay loam, light brownish gray (10YR 6/2) when dry; strong, medium, subangular blocky structure; hard, friable, slightly sticky, slightly plastic; many fine and medium and few coarse roots; strongly acid; abrupt, wavy boundary. 5 to 7 inches thick.

B1t—7 to 14 inches, light brownish-gray (10YR 6/2) heavy silty clay loam, white (10YR 8/2) when dry; few, fine, faint mottles; moderate, medium, prismatic structure and moderate, medium, subangular blocky; very

hard, firm, sticky, plastic; common fine and medium roots; common fine and few medium tubular pores; common moderately thick clay films on peds and in pores; few medium shot; strongly acid; clear, wavy boundary. 5 to 8 inches thick.

B21tg—14 to 22 inches, light brownish-gray (2.5Y 6/2) clay, white (2.5Y 9/2) when dry; strong, medium and fine, prismatic structure and strong, fine and very fine, angular blocky; very hard, very firm, sticky, very plastic; few fine roots; common fine and few medium tubular pores; common moderately thick clay film on peds and in pores; few, medium, distinct, strong-brown (7.5YR 5/8) mottles; few fine shot; common, medium, black manganese dioxide concretions and stains; strongly acid; abrupt, wavy boundary. 7 to 9 inches thick.

B22tg—22 to 30 inches, light olive-gray (5Y 6/2) clay, white (5Y 8/2) when dry; strong, medium and fine, prismatic structure parting to strong, fine, angular blocky and moderate, medium, subangular blocky; very hard, very firm, sticky, very plastic; few fine roots; common fine tubular pores; many thick clay films on peds and in pores; many, strong, prominent, strong-brown (7.5YR 5/8) mottles; common, medium, black manganese dioxide concretions and stains; medium acid; abrupt, wavy boundary. 8 to 10 inches thick.

B23tg—30 to 35 inches, gray (5Y 6/1) clay, light gray (5Y 7/1) when dry; strong, coarse and medium, prismatic structure and strong, very fine, angular blocky; very hard, very firm, sticky, very plastic; no roots; common fine tubular pores; many thick clay films on peds and in pores; few, fine, distinct, strong-brown (7.5YR 5/8) and reddish-brown (5YR 5/3) mottles; medium acid; abrupt, wavy boundary. 3 to 6 inches thick.

B24tg—35 to 63 inches, gray (5Y 6/1) clay, light gray (5Y 7/1) when dry; strong, fine, angular blocky structure; very hard, very firm, sticky, very plastic; no roots; few very fine tubular pores; many thick clay films on peds and in pores; few, fine, distinct, strong-brown (7.5YR 5/8) and reddish-brown (5YR 5/3) mottles; medium acid; abrupt, wavy boundary. 27 to 30 inches thick.

B25tg—63 to 70 inches, greenish-gray (5Y 6/1) clay, light greenish gray (5GY 7/1) when dry; moderate, medium, prismatic structure and strong, fine, angular blocky; extremely hard, very firm, sticky, and very plastic; no roots; very few fine tubular pores; many thick clay films on peds and in pores; strong, prominent, yellowish-brown (10YR 5/8) mottles; medium acid.

Color of the A1 horizon ranges from 4 to 5 in value, from 2 to 3 in chroma, and from 10YR to 2.5Y in hue. Color of the B2tg horizon ranges from 5Y to 10YR in hue and from 5 to 6 in value. Reaction ranges from very strongly acid to medium acid. In places this soil is mottled throughout the profile. In other places it is mottle free to a depth of about 15 inches. The depth to clay is about 10 to 20 inches.

Included in mapping are small areas of a moderately deep soil, areas where the slope is more than 30 percent or less than 8 percent, areas of soils that have a silt loam surface layer, and areas of soils that are cobbly throughout the profile. Also included are small areas of a well-drained soil that has a silty clay loam subsoil.

This Coweeman soil is very slowly permeable and holds about 7 to 8 inches of water that plants can use. Surface runoff is medium to rapid, and the hazard of erosion is moderate to severe. There is a seasonal high water table at a depth of 1 to 2 feet.

This soil is used for timber, hay, and pasture. Capability unit IVe–6; woodland group 3d2; wildlife group 3.

Coweeman silt loam, 5 to 15 percent slopes (CwC).—This soil is on uplands. It is similar to Coweeman silty clay loam, 8 to 30 percent slopes, but it is about 24 inches deep over clay, and the surface layer is silt loam. Mottles are generally below a depth of 12 inches.

Included in mapping are small areas of soils that have a silty clay loam surface layer and are shallow over clay, small areas of well-drained soils that have a silty clay loam subsoil, and small areas where slopes are more than 15 percent or less than 5 percent.

Surface runoff is medium, and the hazard of erosion is slight to moderate. The soil holds about 9 inches of water that plants can use.

This soil is used for timber, hay, and pasture. Capability unit IIIe–4; woodland group 3d2; wildlife group 3.

Coweeman Series, Dark Variant

The dark variant of the Coweeman series is a poorly drained soil on concave terraces. It formed in old sediments from basaltic and andesitic rocks. Slopes are 0 to 4 percent. The annual precipitation is 45 to 65 inches. The mean annual air temperature is about 51° F., and the frost-free season is 165 to 180 days. Elevations range from 300 to 600 feet.

In a representative profile, the upper 9 inches is very dark gray silty clay loam. The subsoil, to a depth of more than 60 inches, is mottled dark grayish-brown clay. The soil is strongly acid in the upper part of the profile and neutral below.

Vegetation is Douglas-fir, western redcedar, Oregon ash, cottonwood, and western hemlock and an understory of salal, willow, sedges, rushes, wild rose, and bracken.

This soil is used principally for timber. Cleared areas are used for hay and pasture.

Coweeman silty clay loam, dark variant, 0 to 4 percent slopes (CyB).—This soil is in small, concave tracts on terraces.

Representative profile of Coweeman silty clay loam, dark variant, in brushland, approximately 13 miles east of Castle Rock. About 320 feet north of Sightly Road and about 320 feet north and 600 feet east of the southwest corner of sec. 32, T. 10 N., R. 1 E.:

A1g—0 to 5 inches, very dark gray (10YR 3/1) light silty clay loam, gray (10YR 5/1) when dry; strong, fine, subangular blocky structure; hard, firm, sticky, slightly plastic; many fine and medium roots; a few dark manganese specks; common, fine, faint, reddish-brown (5YR 5/4) mottles, yellowish red (5YR 5/6) when dry; strongly acid; clear, smooth boundary. 4 to 6 inches thick.

B1g—5 to 9 inches, very dark gray (10 YR 3/1) silty clay loam, gray (10YR 5/1) when dry; weak, medium, prismatic structure and strong, fine, subangular blocky; hard, firm, sticky, plastic; many fine and medium roots; many manganese specks; common fine tubular pores; thin gray sandy coatings on ped faces; common, fine, faint, dark reddish-brown (5YR 3/4) mottles, yellowish red when dry; strongly acid; clear, smooth boundary. 3 to 6 inches thick.

B21tg—9 to 23 inches, dark grayish-brown (10YR 4/2) clay, dark gray (10YR 4/1) when dry; strong, coarse, prismatic structure and moderate, medium, angular blocky; very hard, extremely firm, sticky, very plastic; many fine and very fine roots; few medium roots; about 5 percent gravel 2 to 5 millimeters in diameter; many fine and few coarse tubular pores; thin continuous clay films on vertical faces of prisms, top and bottom faces of coarse prisms slant about 15 percent and have thick continuous clay films and

slickensides; few, medium, distinct, reddish-brown (5YR 4/4) mottles, yellowish red (5YR 4/6) when dry; strongly acid; gradual, smooth boundary. 10 to 15 inches thick.

B22tg—23 to 60 inches, dark grayish-brown (10YR 4/2) clay, dark gray (10YR 4/1) when dry; strong, coarse, prismatic structure and moderate, fine, angular blocky; very hard, extremely firm, sticky, very plastic; few fine and medium roots at a depth of 26 inches, very few very fine roots to a depth of 30 inches and about 5 percent gravel 2 to 5 millimeters in diameter; many fine and few medium pores to a depth of 30 inches, common very fine tubular pores below a depth of 30 inches; thin continuous clay films on vertical faces of prisms, top and bottom faces of coarse prisms slant about 15 percent and have thick continuous clay films and slickensides; many, medium, distinct, reddish-brown (5YR 4/4) mottles, yellowish red (5YR 5/6) when dry; neutral.

In the A1 horizon the color value is 2 or 3, chroma is 1 or 2, and hue ranges from 10YR to 5Y. This soil is mottled to the surface in some places. The depth to clay ranges from 7 to 15 inches.

Included in mapping are small tracts of moderately deep soils where the slope is more than 4 percent, small areas of well-drained soils that have a silty clay subsoil, and small areas of soils that have a clay surface layer.

This Coweeman soil is very slowly permeable and holds about 7 to 8 inches of water that plants can use. Runoff is very slow, and the hazard of erosion is none to slight. There is a seasonal high water table within a depth of 1 foot.

This soil is used for timber, hay, and pasture. Capability unit IVw–2; woodland group 4d1; wildlife group 3.

Gee Series

The Gee series consists of moderately well drained soils that are underlain by clay at a depth of 4 to 4½ feet. These soils formed in old alluvium on high terraces. Slopes are 0 to 40 percent. The annual precipitation is 45 to 55 inches. The mean annual air temperature is about 51° F., and the frost-free season is 165 to 180 days. Elevations range from 300 to 700 feet.

In a representative profile, the surface layer is silt loam to a depth of about 12 inches. It is very dark grayish brown in the upper part and dark brown in the lower part. The subsoil is silty clay loam to a depth of about 53 inches. It is dark brown and yellowish brown in the upper part, dark yellowish brown in the middle, and brown and yellowish brown and distinctly mottled in the lower part. Beneath this, to a depth of more than 72 inches, is dark-brown clay. The soil is medium acid to very strongly acid throughout the profile; acidity increases with increasing depth.

Vegetation is Douglas-fir, red alder, bigleaf maple, and black cottonwood.

About half the acreage is used for timber. Cleared areas are used principally for hay and pasture and for homesites.

Gee silt loam, 8 to 15 percent slopes (GeC).—This soil is on old, high terrace remnants. It is associated with Kalama, Rose Valley, and Kelso soils.

Representative profile of Gee silt loam, in pasture, in a cut bank in a gravel pit, about 1 mile northeast of Kelso. About 500 feet southeast of Mt. Brynion Road and 625 feet west and 840 feet north of the southeast corner of sec. 23, T. 8 N., R. 2 W.:

A11—0 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) when dry; moderate, very fine and fine, subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; many fine and medium roots; few, fine, yellowish-red (5YR 4/6) shot; few small pebbles; medium acid; clear, wavy boundary. 5 to 8 inches thick.

A12—7 to 12 inches, dark-brown (10YR 3/3) silt loam, brown (7.5YR 5/2) when dry; moderate, very fine and fine, subangular blocky structure; hard, friable, slightly sticky, slightly plastic; many fine and medium roots; few fine tubular pores; few, fine, yellowish-red (5YR 4/6) shot; few small pebbles; medium acid; clear, wavy boundary. 4 to 7 inches thick.

B21t—12 to 22 inches, dark-brown (10YR 4/3) silty clay loam, brown (7.5YR 5/4) when dry; moderate, very fine and fine, subangular blocky structure; hard, firm, sticky, slightly plastic; common fine roots; common fine and few medium tubular pores; thin, patchy, dark-brown (7.5YR 4/4) clay films; few, fine, yellowish-red (5YR 4/6) shot; few small pebbles; strongly acid; clear, wavy boundary. 9 to 12 inches thick.

B&A1—22 to 38 inches, dark yellowish-brown (10YR 4/4) silty clay loam, light yellowish brown (10YR 5/4) when dry; some thin gray (10YR 5/1) silt loam coatings on faces of prisms, gray (10YR 5/1) and light gray (10YR 7/2) when dry; moderate, medium, prismatic structure and moderate, very fine and fine, angular blocky; hard, firm, sticky, plastic; few fine roots; few coarse and medium and common fine tubular pores; moderately thick, continuous, reddish-brown clay films on peds and in pores; common, medium, distinct mottles, strong brown (7.5YR 5/6) when moist; few, fine, yellowish-red shot; common small pebbles; common, medium, black manganese concretions; strongly acid; clear, wavy boundary. 14 to 18 inches thick.

B&A2—38 to 47 inches, brown (10YR 5/3) silty clay loam, light yellowish brown (10YR 6/4) when dry; about 12 percent light brownish-gray (10YR 6/2) vertical silt loam coatings on prisms, white (10YR 8/1) when dry; strong, medium and coarse, prismatic structure and moderate, coarse, angular blocky; very hard, very firm, sticky, plastic; few fine roots; common fine and few medium tubular pores; medium, continuous, reddish-brown clay films on ped faces and in pores; common, medium, distinct mottles in bands paralleling the vertical gray silt loam coatings, strong brown (7.5YR 5/6) when moist; few, fine, strong-brown shot; common small pebbles; common, medium, black manganese dioxide concretions; strongly acid; abrupt, wavy boundary. 5 to 10 inches thick.

B22tcn—47 to 53 inches, yellowish-brown (10YR 5/4) silty clay loam, very pale brown (10YR 7/4) when dry; massive; hard, extremely firm, sticky, plastic; few fine roots; few medium tubular pores; medium, patchy, reddish-brown (5YR 4/3) clay films in matrix; common, fine, prominent, yellowish-red (5YR 4/6) and few, fine, faint, very pale brown (10YR 7/3) mottles; no gravel; many, medium, black manganese dioxide concretions; strongly acid; abrupt, wavy boundary. 4 to 8 inches thick.

B23t—53 to 72 inches, dark-brown (10YR 4/3) clay, light yellowish brown (10YR 6/4) when dry; few, medium, distinct, light-gray (5Y 7/2) silt loam coatings on prism faces; strong, medium and coarse, prismatic structure and strong, medium, angular blocky; very hard, very firm, sticky, very plastic; few fine roots in the upper 10 inches and none at depths below; few fine tubular pores; thick, continuous, dark-brown (10YR 4/3) clay films, dark brown (7.5YR 4/2) when dry; common, medium, distinct, strong-brown (7.5YR 5/6) mottles appearing in bands paralleling the vertical gray silt loam coat-

ings; no gravel; very strongly acid; clear, wavy boundary. 18 to 21 inches thick.

The texture of the A1 horizon ranges from silt loam to light silty clay loam. Hue of the A horizon ranges from 7.5YR to 10YR, and value ranges from 2 to 3. Hue of the B2t and B&A horizons ranges from 5YR to 10YR and chroma from 2 to 4. Chroma of the silt loam coatings in the B&A horizon ranges from 1 to 3.

Included in mapping are small areas of shallow, somewhat poorly drained soils that have a clay subsoil, small areas of very deep soils, and small areas where slopes are more than 15 percent.

This Gee soil is very slowly permeable and holds about 10 inches of water that plants can use. Runoff is medium, and the erosion hazard is moderate. The extremely firm, black manganese layer above the clay greatly restricts root penetration and the downward movement of water. There is a seasonal high water table at a depth of 2 to 4 feet.

Hay, pasture, and small grain are the principal crops. This soil is well suited to Douglas-fir. Capability unit IIIe–2; woodland group 3d3; wildlife group 1.

Gee silt loam, 0 to 8 percent slopes (GeB).—This soil is similar to Gee silt loam, 8 to 15 percent slopes, but the layer above the clay layer is very firm and has fewer manganese oxide concretions. Runoff is slow, and the hazard of erosion is slight.

Almost all the acreage has been cleared and is used for hay, pasture, and homesites. A small acreage is used for timber production, principally Douglas-fir. Capability unit IIIe–2; woodland group 3d3; wildlife group 1.

Gee silt loam, 15 to 40 percent slopes (GeD).—Included with this soil in mapping are small areas where the slope is more than 40 percent. Runoff is medium to rapid. In cleared areas the erosion hazard is moderate to severe.

This soil is used chiefly for timber. Only a small acreage has been cleared. Capability unit VIe–1; woodland group 3d3; wildlife group 3.

Germany Series

The Germany series consists of well-drained soils that formed in silty, wind-laid deposits on the uplands in the western part of the Cowlitz Area. Slopes are 0 to 50 percent. The annual precipitation is 50 to 70 inches. The mean annual air temperature is about 51° F., and the frost-free season is 165 to 180 days. Elevations range from 200 to 1,400 feet.

In a representative profile the surface layer is very dark brown and dark-brown silt loam about 22 inches thick. The subsoil is dark-brown heavy silt loam to a depth of 72 inches or more. The soil is very strongly acid and strongly acid throughout the profile. In places it is cobbly.

Vegetation is Douglas-fir, western hemlock, western redcedar, and red alder and an understory of bracken, swordfern, and vine maple.

These soils are used principally for timber production, but some are used for hay, pasture, cane fruit, strawberries, and potatoes.

Germany silt loam, 20 to 30 percent slopes (GmD).—This soil is on mountainsides. Areas are large and irregularly shaped. Slopes are dominantly 22 to 26 percent.

Representative profile of Germany silt loam, in woodland, in a pit about 8 miles northeast of Longview and 250 feet north of the Eufala Heights Road, at a point 220 feet east and 750 feet south of the northwest corner of sec. 3, T. 8 N., R. 3 W.:

A11—0 to 2 inches, very dark brown (10YR 2/2) silt loam, dark brown (7.5Y 3/2) when dry; moderate, medium, granular structure; soft, very friable, nonsticky, nonplastic; many fine, medium, and coarse roots; few fine iron shot; very few angular pebbles; very strongly acid; abrupt, wavy boundary. ½ to 4 inches thick.

A12—2 to 22 inches, dark-brown (10YR 3/3) silt loam, dark brown (7.5YR 4/4) when dry; moderate, fine, subangular blocky structure; slightly hard, friable, nonsticky, nonplastic; many fine, medium, and coarse roots; common fine tubular and common fine interstitial pores; very few angular pebbles; common fine shot; strongly acid; diffuse, wavy boundary. 17 to 24 inches thick.

B21—22 to 49 inches, dark-brown (10YR 4/3) heavy silt loam, yellowish brown (10YR 5/4) when dry; moderate, fine, subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; common fine and medium roots to a depth of 40 inches, few fine roots between depths of 40 and 49 inches; common fine tubular and common fine interstitial pores; thin patchy clay films on peds; common fine shot; few angular pebbles; strongly acid; clear, smooth boundary. 23 to 30 inches thick.

B22—49 to 72 inches, dark-brown (7.5YR 4/4) heavy silt loam, light yellowish brown (10YR 6/4) when dry; moderate, fine, subangular blocky structure; hard, firm, slightly sticky, slightly plastic; few fine roots to a depth of 60 inches, none below; common fine tubular pores; thin patchy to thin continuous clay films on peds; common fine shot; a few angular pebbles in upper part and a moderate amount of irregularly shaped pebbles in lower part; few, fine, faint mottles when dry; strongly acid; diffuse, wavy boundary. 34 to 44 inches thick.

Color of the A1 horizon ranges from 2 to 3 in value and from 2 to 4 in chroma and is 7.5YR and 10YR in hue. The B2 horizon ranges from 3 to 4 in value and chroma. The A1 horizon and the upper part of the B2 horizon contain from few to many soft shot concretions. In places they are as much as 25 percent concretions.

Included in mapping are small areas of soil underlain by extremely firm, weakly cemented gravel at a depth of about 36 inches. This soil is along Coal Creek in the western part of Cowlitz County.

This Germany soil is moderately permeable and holds more than 10 inches of water that plants can use. Surface runoff is medium to rapid, and the hazard of erosion is moderate to severe.

This soil is used for woodland and wildlife habitat. Capability unit IVe–1; woodland group 1o1; wildlife group 7.

Germany silt loam, 0 to 8 percent slopes (GmB).—This soil is on broad ridgetops. It is similar to Germany silt loam, 20 to 30 percent slopes, but the subsoil is slightly more brittle and firm.

Surface runoff is slow, and the hazard of erosion is slight.

This soil is used mainly for woodland, but it is also used for hay, pasture, strawberries, and potatoes. Capability unit IIe–2; woodland group 1o1; wildlife group 4.

Germany silt loam, 8 to 20 percent slopes (GmC).—This soil is similar to Germany silt loam, 20 to 30 percent slopes, but the subsoil is slightly more brittle and firm. It is near the edges of broad ridgetops and on hillsides. Included are gravelly and cobbly soils.

Surface runoff is medium, and the hazard of erosion is moderate.

Woodland is the main use of this soil, but small acreages are used for hay and pasture. Capability unit IIIe–1; woodland group 1o1; wildlife group 4.

Germany silt loam, 30 to 50 percent slopes (GmE).—This soil is in large, irregularly shaped tracts in mountainous terrain. Slopes are mainly 35 to 45 percent. Included in mapping are small areas of soils that have gravel and cobblestones in the profile and small areas where the slope is either less than 30 percent or more than 50 percent.

Surface runoff is rapid, and the hazard of erosion is severe.

This soil is used mainly for timber production and wildlife habitat. Capability unit VIe–1; woodland group 1r1; wildlife group 7.

Germany cobbly silt loam, 20 to 30 percent slopes (GnD).—This soil is similar to Germany silt loam, 20 to 30 percent slopes, but it has a cobbly surface layer, has few to many cobblestones in the rest of the profile, and it holds about 8 inches of water that plants can use.

This soil is used for woodland and wildlife habitat. Capability unit IVe–1; woodland group 1o1; wildlife group 7.

Germany cobbly silt loam, 30 to 50 percent slopes (GnE).—This soil is similar to Germany silt loam, 20 to 30 percent slopes, but it has a cobbly surface layer and few to many cobblestones in the rest of the profile. It is in large, irregularly shaped tracts on hillsides. In most places slopes are 35 to 45 percent.

Included in mapping are small areas of soils that have a gravelly surface layer and few to many pebbles in the rest of the profile, small areas where the soil is almost free of cobblestones and pebbles, and small areas where the slope is either less than 30 percent or more than 50 percent.

This soil is used mainly for timber and wildlife habitat. Capability unit VIe–1; woodland group 1r1; wildlife group 7.

Godfrey Series

The Godfrey series consists of somewhat poorly drained and poorly drained soils that formed in alluvium from basic volcanic and sedimentary material. These soils are on flood plains of many of the streams and rivers of the county. Slopes are 0 to 3 percent. The annual precipitation is 38 to 65 inches. The mean annual air temperature is 52° F., and the frost-free season is 165 to 180 days. Elevations range from 20 to 300 feet.

In a representative profile, the surface layer is dark-gray silt loam about 5 inches thick. The subsoil, to a depth of about 27 inches, is gray silty clay loam. The substratum is dark-gray sandy clay and clay. The soil is distinctly mottled and very strongly acid to neutral. In places the surface layer is silty clay loam.

Vegetation is a mixture of red alder, western redcedar, bigleaf maple, Douglas-fir, and black cottonwood trees and an understory of shrubs and herbs.

Godfrey soils are used for hay, pasture, and small grain.

Godfrey silt loam (Go).—This soil is on flood plains of many of the main rivers and their tributaries. In places it is in depressions. Slopes are dominantly 2 to 3 percent.

Representative profile of Godfrey silt loam, in brushland, approximately 5 miles north of Kelso and 90 feet south of Washburn Road at a point 520 feet west of the intersection of Washburn Road and Interstate Highway No. 5. About 440 feet east and 375 feet north of the center of sec. 2, T. 8 N., R. 2 W.:

A1g—0 to 5 inches, dark-gray (10YR 4/1) heavy silt loam, light brownish gray (10YR 6/2) when dry; moderate, fine, subangular blocky structure; hard, friable, slightly sticky, plastic; many fine and medium roots; many fine and common fine tubular pores; common, fine, distinct, dark reddish-brown (5YR 3/4) mottles, yellowish red (5YR 4/8) when dry; very strongly acid; gradual, smooth boundary. 4 to 7 inches thick.

B2g—5 to 27 inches, gray (10YR 5/1) silty clay loam, light gray (10YR 6/1) when dry; structure is weak coarse prismatic, weak medium subangular blocky, and weak medium angular blocky; hard, firm, sticky, plastic; many fine roots at a depth of 8 to 27 inches; many fine and common medium tubular pores; many, medium, distinct, yellowish-red (5YR 4/6) mottles, yellowish red (5YR 4/8) when dry; medium acid; gradual, smooth boundary. 20 to 28 inches thick.

IIC1g—27 to 33 inches, dark-gray (5Y 4/1) sandy clay, grayish brown (10YR 5/2) when dry; massive; slightly hard, firm, sticky, plastic; common fine roots; common medium tubular pores; few, medium, distinct mottles; neutral; gradual, smooth boundary. 4 to 9 inches thick.

IIIC2g—33 to 60 inches, dark-gray (5Y 4/1) clay, gray (10YR 5/1) when dry; massive; very hard, firm, sticky, very plastic; no roots; common medium tubular pores; common, fine, prominent, reddish-brown (5YR 5/4) mottles when dry; neutral.

Color of the A1g horizon ranges from 4 to 5 in value and from 1 to 2 in chroma. The hue of the B2g and Cg horizons ranges from 10YR to 5Y and the value from 4 to 5. In places there are no mottles in the A1g horizon.

Included in mapping are small areas of soils that have a silty clay loam surface layer, small areas of soils that have a silt loam subsoil, and small areas of gravelly soils.

This Godfrey soil is somewhat poorly drained and slowly permeable. The seasonal water table is within a depth of 2 feet during wet periods in winter and spring. Surface runoff is very slow to slow. There is a slight to moderate hazard of erosion from flooding. The soil holds about 7 to 8 inches of water that plants can use.

This soil is used for hay, pasture, and small grain. Capability unit IIIw–2; woodland group 3d2; wildlife group 3.

Godfrey silty clay loam (Gr).—This soil is similar to Godfrey silt loam, but it is about 1 foot lower in elevation, it is poorly drained, and its surface layer differs in texture and is 10 to 12 inches thick.

Included in mapping are small areas of soils that have a clay or silt loam surface layer and small areas that have rock flour silty layers in the subsoil.

This Godfrey soil is used for hay, pasture, and small grain. It is suitable for farm ponds (fig. 8). Capability unit IIIw–2; woodland group 3d2; wildlife group 3.

Figure 8.—**Trout ponds in Godfrey silty clay loam.**

Hillsboro Series

The Hillsboro series consists of well-drained soils that formed in old sediment of mixed origin. These soils are on terraces and terrace fronts. Slopes are 0 to 40 percent. The annual precipitation is 38 to 45 inches. The mean annual air temperature is about 52° F., and the frost-free season is 165 to 180 days. Elevations range from 75 to 250 feet.

In a representative profile, the surface layer is dark-brown silt loam about 9 inches thick. The subsoil is dark yellowish-brown silt loam to a depth of 28 inches, and dark-brown very fine sandy loam to a depth of 43 inches. Below the subsoil to a depth of more than 78 inches is dark grayish-brown fine sandy loam and fine sand. The soil is slightly acid to neutral throughout the profile.

Vegetation is Douglas-fir, red alder, bigleaf maple, and bitter cherry and an understory of salmonberry, elderberry, and evergreen blackberry.

These soils are used for hay, pasture, bulbs, and woodland and are suited to almost all of the crops grown in the Area.

Hillsboro silt loam, 0 to 40 percent slopes (HlD).—This soil is in moderately large tracts on terraces and terrace fronts.

Representative profile of Hillsboro silt loam, in fallow, on a high bench approximately 1 mile north of Woodland and about 50 feet east from the trees in a plowed field. NW¼SE¼SE¼SE¼ of sec. 12, T. 5 N., R. 1 W.:

Ap1—0 to 9 inches, dark-brown (10YR 3/3) silt loam, brown (10YR 5/3) when dry; moderate, medium, subangular blocky and moderate, fine, granular

structure; slightly hard, friable, slightly sticky, nonplastic; common medium and fine roots; neutral; abrupt, wavy boundary. 7 to 11 inches thick.

B1—9 to 17 inches, dark yellowish-brown (10YR 3/4) silt loam, dark brown (7.5YR 4/4) when dry; moderate, fine, angular blocky and moderate, very fine, subangular blocky structure; hard, friable, slightly sticky, slightly plastic; no roots; common fine and few coarse tubular pores; very thin clay film in pores; slightly acid; clear, wavy boundary. 7 to 13 inches thick.

B2t —17 to 28 inches, dark yellowish-brown (10YR 4/4) silt loam, yellowish brown (10YR 5/4) when dry; structure is weak medium prismatic, moderate medium, and weak fine subangular blocky; hard, friable, slightly sticky, slightly plastic; no roots; common fine tubular pores; thin clay film in pores and few thin patches on peds; a few manganese dioxide concretions; slightly acid; clear, wavy boundary. 11 to 24 inches thick.

B3t—28 to 43 inches, dark-brown (10YR 4/3) very fine sandy loam, pale brown (10YR 6/3) when dry; weak, medium and fine, subangular blocky structure; slightly hard, very friable, nonsticky, nonplastic; no roots; common fine tubular pores; thin clay film in pores; slightly acid; clear, wavy boundary. 6 to 15 inches thick.

C1—43 to 50 inches, dark grayish-brown (10YR 4/2) fine sandy loam, pale brown (10YR 6/3) when dry; massive; hard, firm, slightly brittle, nonsticky, nonplastic; no roots; few fine and coarse tubular pores; no clay films; a few manganese dioxide concretions; slightly acid; abrupt, wavy boundary. 4 to 12 inches thick.

C2—50 to 78 inches, dark grayish-brown (2.5Y 4/2) fine sand, light brownish gray (10YR 6/2) when dry; single grain; soft, loose, nonsticky, nonplastic; slightly acid.

Color value of the A1 horizon is 3, and chroma ranges from 3 to 2. In places the A1 horizon is loam. The B2 horizon ranges from 3 to 4 in value and from 2 to 4 in chroma. Its texture ranges from silt loam to very fine sandy loam. Soil reaction is mostly slightly acid, but ranges from neutral to medium acid throughout the profile.

Included in mapping are small areas of moderately well drained soils that have a mottled subsoil and small areas of somewhat poorly drained soils that have clay at an average depth of 24 inches.

This Hillsboro soil is moderately permeable and holds about 10 inches of water that plants can use. Surface runoff is slow to rapid, and the hazard of erosion is slight to severe.

This soil is used for bulbs, hay, pasture, and timber and is suited to almost all of the crops grown in this Area. Capability unit IIe–1 for slopes of 0 to 8 percent, IVe–1 for slopes of 8 to 30 percent, and VIe–1 for slopes of 30 to 40 percent; wildlife group 2 for slopes of 0 to 30 percent and group 7 for slopes of 30 to 40 percent; woodland group 3o1 for slopes of 0 to 30 percent and 3r1 for slopes of 30 to 40 percent.

Kalama Series

The Kalama series consists of moderately well drained soils that formed on high terraces in old lake and stream sediment near the Columbia, Cowlitz, Coweeman, Kalama, and Lewis Rivers. Slopes are 0 to 60 percent. The annual precipitation is 45 to 60 inches. The mean annual air temperature is about 51° F., and the frost-free season is 165 to 180 days. Elevations range from 100 to 500 feet.

In a representative profile, the surface layer is very dark brown gravelly loam about 5 inches thick. The subsoil is dark-brown gravelly clay loam and gravelly sandy clay to a depth of about 34 inches. The substratum is brownish-yellow very gravelly clay loam. The soil is slightly acid to strongly acid throughout the profile.

Vegetation is mostly Douglas-fir, red alder, bigleaf maple, and western redcedar.

These soils are used mostly for woodland. Cleared areas are used principally for hay and pasture and for homesites.

Kalama gravelly loam, 15 to 30 percent slopes (KaD).—This soil is on dissected terraces parallel to the drainageways. Tracts are irregular in shape and generally narrow and long. This soil is associated with Rose Valley, Kelso, and Gee soils.

Representative profile of Kalama gravelly loam, in woodland, approximately 2 miles northeast of Kelso on Holcomb Acres Road and 700 feet west of the northeast corner of sec. 23, at a point 75 feet south of Holcomb Acres Road. NE¼NW¼NE¼NE¼ sec. 23, T. 8 N., R. 2 W.:

A1—0 to 5 inches, very dark brown (10YR 2/2) gravelly loam, grayish brown (10YR 5/2) when dry; moderate, fine, subangular blocky structure; slightly hard, friable, slightly sticky, nonplastic; many fine and medium roots; slightly acid; clear, wavy boundary. 4 to 6 inches thick.

B1—5 to 16 inches, dark-brown (10YR 4/2) gravelly clay loam, pale brown (10YR 6/3) when dry; moderate, fine and very fine, subangular blocky structure; hard, firm, sticky, slightly plastic; many fine and medium roots in the upper 10 inches, common fine and medium roots in the lower 6 inches; many fine tubular pores; few thin clay films in pores; strongly acid; clear, wavy boundary. 9 to 12 inches thick.

B21t—16 to 23 inches, variegated colors of dark-brown (10YR 4/3 and 7.5YR 4/2) gravelly clay loam, very pale brown (10YR 7/4) and brown (7.5YR 5/4) when dry; few, medium, prominent, reddish-brown (5YR 4/4) and yellowish-red (5YR 4/6) mottles when dry; moderate fine and strong, medium, subangular blocky structure; hard, very firm, sticky, plastic; common fine and medium roots; many fine tubular pores; many moderately thick clay films on gravel and ped faces; medium acid; clear, wavy boundary. 6 to 8 inches thick.

B22t 23 to 34 inches, variegated colors of dark-brown (10YR 4/3 and 7.5YR 4/2) gravelly sandy clay, very pale brown (10YR 7/4) and strong brown (7.5YR 5/6) when dry; moderate very fine and strong, fine, subangular blocky structure; hard, very firm, sticky, plastic; common fine roots; many fine tubular pores; many moderately thick clay films on gravel and ped surfaces; medium acid; clear, wavy boundary. 9 to 12 inches thick.

C1—34 to 58 inches, brownish-yellow (10YR 6/6) very gravelly clay loam, yellow (10YR 7/6) when dry; massive; hard, extremely firm, slightly sticky, nonplastic; few fine roots; many moderately thick clay films around pebbles; medium acid; clear, wavy boundary. 22 to 30 inches thick.

C2—58 to 72 inches, yellowish-brown (10YR 5/9) very gravelly heavy clay loam, yellow (10YR 7/6) when dry; massive; hard, very firm, sticky, plastic; no roots; few thin clay films around pebbles; medium acid.

Color of the A1 horizon ranges from 2 to 3 in value and chroma. The B2t horizon has variegated colors that range in value from 3 to 4, in chroma from 2 to 4, and in hue from 7.5YR to 10YR. The C horizon ranges in value from 4 to 6, in chroma from 3 to 8, and in hue from 7.5YR to 10YR. Moist consistence in the C horizon ranges from firm to extremely firm.

Included in mapping are small areas of somewhat poorly drained soils that have a clay subsoil or a subsoil that contains common manganese dioxide concretions and strains. Also included are areas of soil that do not have an extremely firm, very gravelly clay loam layer, and small areas that have a gravelly silt loam A1 horizon.

This Kalama soil is slowly permeable and holds about 8 inches of water that plants can use. Surface runoff is medium to rapid, and the erosion hazard is moderate to severe. The extremely firm very gravelly clay loam layer restricts the penetration of roots and the movement of water.

Most of the acreage is wooded. A small acreage is used for pasture. Capability unit IVe–1; woodland group 3d1; wildlife group 7.

Kalama gravelly loam, 0 to 8 percent slopes (KaB).—This soil has slow runoff and a slight erosion hazard.

Cleared areas are used for hay, pasture, and homesites. Much of the acreage is still wooded. Capability unit IIIe–2; woodland group 3d1; wildlife group 4.

Kalama gravelly loam, 8 to 15 percent slopes (KaC).—This soil has medium runoff and a moderate erosion hazard.

Cleared areas are used for hay, pasture, and homesites. Much of the acreage is wooded. Capability unit IIIe–2; woodland group 3d1; wildlife group 4.

Kalama gravelly loam, 30 to 60 percent slopes (KaE).—This soil has rapid to very rapid runoff and a severe to very severe erosion hazard. Slopes are dominantly less than 50 percent.

This soil is used mostly for woodland. Capability unit VIe–1; woodland group 3d1; wildlife group 7.

Kelso Series

The Kelso series consists of moderately well drained soils that formed in old stream and lake sediment on high terraces near the Cowlitz, Columbia, Cowcman, and Lewis Rivers. Slopes are 0 to 50 percent. The annual precipitation is 40 to 60 inches. The mean annual air temperature is about 51° F., and the frost-free season is 165 to 180 days. Elevations range from 50 to 200 feet.

In a representative profile, the soil is very dark grayish-brown and dark-brown silt loam to a depth of about 16 inches. Between depths of 16 and 60 inches are stratified layers of dark-brown, yellowish-red and dark grayish-brown silt loam. There are some brown and yellowish-red mottles and some black manganese stains and concretions below a depth of 23 inches. The soil is slightly acid to medium acid throughout the profile.

Vegetation is principally Douglas-fir, western redcedar, bigleaf maple, and alder.

Most of the acreage is woodland. Cleared areas are used mainly for hay and pasture and for homesites.

Kelso silt loam, 0 to 8 percent slopes (KeB).—This soil is on terraces.

Representative profile of Kelso silt loam, in woodland, approximately 5.1 miles north of North Kelso overpass and 4.4 miles south of Castle Rock overpass. 150 feet east of Interstate Highway No. 5 and 15 feet east of split rail fence at top of forested hill, at a point 250 feet south and 680 feet west of the east quarter corner of sec. 25, T. 9 N., R. 2 W.:

O1—1 to ½ inch, needles, twigs, leaves, and moss; abrupt, wavy boundary. ½ to 2 inches thick.

O2—½ inch to 0, matted, greasy, decomposing needles, leaves, and twigs; abrupt, wavy boundary. ½ to 1 inch thick.

A1—0 to 8 inches, very dark grayish-brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) when dry; strong, fine and very fine, subangular blocky structure; hard, friable, slightly sticky, slightly plastic; many coarse and medium roots; few very fine tubular pores; few fine iron and manganese shot; slightly acid; clear, wavy boundary. 6 to 11 inches thick.

A3—8 to 16 inches, dark-brown (10YR 3/3) silt loam, brown (10YR 5/3) when dry; strong, fine and very fine, subangular blocky structure; hard, friable, slightly sticky, plastic; many coarse, medium, and fine roots; few very fine tubular pores; few fine iron and manganese shot; medium acid; clear, wavy boundary. 4 to 12 inches thick.

B2—16 to 23 inches, dark-brown (10YR 4/3) heavy silt loam, light yellowish brown (10YR 6/4) when dry; moderate, medium and fine, angular blocky structure; hard and very hard, firm, sticky, slightly plastic; many medium and fine roots to a depth of 20 inches, common medium and fine roots to a depth of 23 inches; many fine tubular pores; few fine iron and manganese shot; medium acid; clear, wavy boundary. 5 to 9 inches thick.

B&A'—23 to 38 inches, yellowish-red (5YR 4/6) silt loam, yellowish red (5YR 5/6) when dry; many vertical tongues ⅛ to ½ inch wide of grayish-brown (2.5YR 5/2) silt loam, light gray (10YR 7/2) when dry; common, fine, distinct, yellowish-red (5YR 4/6) mottles, strong brown (7.5YR 5/6) when dry; moderate, medium and fine, angular blocky structure; very hard, firm, sticky, plastic; few medium and fine roots; common fine tubular pores, thin continuous clay films in pores; few, thin, patchy clay films on ped faces; common, medium, black manganese concretions and stains; medium acid; abrupt, irregular boundary. 8 to 21 inches thick.

B'2t—38 to 47 inches, dark grayish-brown (10YR 4/2) silt loam, brown (10YR 5/3) when dry; common, fine, faint, dark-brown (10YR 4/3) mottles, pale brown (10YR 6/3) when dry; moderate, coarse, prismatic and moderate, fine, angular blocky structure; slightly hard, firm, sticky, slightly plastic; no roots; many fine and very fine tubular pores; thick patchy clay films; few, fine, black manganese concretions and stains; medium acid; clear, wavy boundary. 6 to 12 inches thick.

B'3t—47 to 60 inches, dark grayish-brown (10YR 4/2) silt loam, brown (10YR 5/3) when dry; common, fine, faint, dark-brown (10YR 4/3) mottles, pale brown (10YR 6/3) when dry; massive; slightly hard, firm, sticky, slightly plastic; no roots; many fine tubular pores; thin continuous clay films in pores; medium acid.

The A horizon ranges in value from 2 to 3 and in chroma from 2 to 4. The B2 horizon ranges in value and chroma from 3 to 4. In the B&A' horizon, the B part ranges in value from 3 to 5, in chroma from 2 to 6, and hue is 5YR, 7.5YR, or 10YR. The lower sequum is stratified in places with lenses of sediments that range from fine sandy loam to silty clay.

Included in mapping are small areas of somewhat poorly drained soils that have a clay subsoil or a subsoil that contains common manganese concretions and stains.

This Kelso soil is slowly permeable and holds more than 10 inches of water that plants can use. Surface runoff is slow to medium, and the hazard of erosion is slight.

Pasture, hay, cane fruit, strawberries, and small grain are the principal crops. A large acreage is wooded. Capability unit IIe–3; woodland group 2o1; wildlife group 4.

Kelso silt loam, 8 to 15 percent slopes (KeC).—Included with this soil in mapping are small areas of somewhat poorly drained soils that have a clay subsoil and soils that have a subsoil that contains manganese concretions and stains.

Surface runoff is medium, and the hazard of erosion is moderate to severe.

Woodland is the major use for this soil. Small acreages are used for small grain, hay, pasture, and berries. Some areas are used for homesites. Capability unit IVe–3; woodland group 2o1; wildlife group 4.

Kelso silt loam, 15 to 30 percent slopes (KeD).—Except for slope, this soil is similar to Kelso silt loam, 0 to 8 percent slopes. Surface runoff is rapid. The hazard of erosion is severe.

This soil is used principally for woodland, but small areas are used for pasture. Capability unit IVe–3; woodland group 2o1; wildlife group 7.

Kelso silt loam, 30 to 50 percent slopes (KeE).—This soil is similar to Kelso silt loam, 0 to 8 percent slopes, but generally it is on terrace fronts and is subject to some mixing from soil movement. Surface runoff is rapid to very rapid, and the hazard of erosion is very severe.

Included in mapping are small areas where the slope is either more than 50 percent or less than 30 percent.

This soil is used mainly for woodland. Capability unit VIe–1; woodland group 2r1; wildlife group 7.

Loper Series

The Loper series consists of well-drained soils on mountainsides and ridges. These soils formed in weathered basalt and andesite rocks. Slopes are 3 to 50 percent. The annual precipitation is 70 to 100 inches. The mean annual air temperature is about 47° F., and the frost-free season is 125 to 140 days. Elevations range from 400 to 2,700 feet.

In a representative profile, the surface layer is cobbly silt loam, about 16 inches thick. It is very dark brown in the upper part and dark brown in the lower part. The underlying material, to a depth of 34 inches, is dark-brown gravelly and very gravelly silt loam. At a depth of 34 inches is weathered, shattered rock. The soil is strongly acid to very strongly acid throughout the profile.

The principal vegetation is Douglas-fir, western hemlock, bigleaf maple, red alder, silver fir, and willow and an understory of vine maple, salmonberry, red and blue huckleberry, salal, swordfern, and bracken.

These soils are used for timber production and wildlife habitat.

The Loper soils in the Cowlitz Area are mapped with Bear Prairie soils.

Loper-Bear Prairie complex, 3 to 15 percent slopes (LbC).—This complex is in large, irregularly shaped tracts on broad ridgetops, toe slopes, and mountainsides. It is about 50 percent Loper cobbly silt loam and 40 percent Bear Prairie silt loam.

The Bear Prairie soil is described under the heading "Bear Prairie Series."

Representative profile of Loper soil in an area of the Loper-Bear Prairie complex, in woodland, approximately 25 miles northwest of Kelso on the northwest end of Hemlock Ridge. About 250 feet south on logging road from Road No. 820, at a point 750 feet north and 500 feet west of the southeast corner of sec. 21, T. 10 N., R. 4 W.:

A11—0 to 8 inches, very dark brown (10YR 2/2) cobbly silt loam, dark reddish brown (5YR 3/2) when dry; moderate, fine and very fine, granular structure; soft, very friable, nonsticky, nonplastic; many very fine, fine, and medium and few coarse roots; few shot; strongly acid; clear, wavy boundary. 1 to 9 inches thick.

A12—8 to 16 inches, dark-brown (7.5YR 3/4) cobbly silt loam, dark brown (7.5YR 4/4) when dry; moderate, fine and medium, granular structure; slightly hard, very friable, nonsticky, slightly plastic; many fine and very fine and few coarse and medium roots; few shot; very strongly acid; gradual, wavy boundary. 4 to 20 inches thick.

B2—16 to 27 inches, dark-brown (7.5YR 3/4) gravelly silt loam, dark brown (7.5YR 4/4) when dry; moderate, fine and very fine, subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; common very fine and fine, few medium, and very few coarse roots; very thin patchy clay films on rocks; many angular pebbles and cobblestones; very strongly acid; gradual, wavy boundary. 4 to 24 inches thick.

C1—27 to 34 inches, dark-brown (10YR 4/3) very gravelly silt loam, dark brown (7.5YR 3/2) when dry; massive; slightly hard, firm, slightly sticky, slightly plastic; common very fine and fine, few medium, and very few coarse roots; about 60 percent angular gravel and cobblestones, weathered gravel can be broken into subangular blocks; very strongly acid; gradual, wavy boundary. 5 to 35 inches thick.

R—34 inches, shattered weathered rock; can be readily cut with a knife.

The hue for both moist and dry soil throughout the profile ranges from 7.5YR to 10YR. The A1 horizon ranges from 2 to 3 in value and from 1 to 3 in chroma. The B2 horizon ranges from 3 to 4 in value and from 3 to 5 in chroma. The B2 horizon ranges from gravelly loam to gravelly light silty clay loam and is 15 to 50 percent gravel and cobblestone.

Included in mapping are areas of Rock land, small areas where the slope is less than 3 percent or more than 15 percent, and small areas of soils that have a sandy subsoil.

The Loper and Bear Prairie soils are moderately permeable. The Loper soil holds about 5 inches of water that plants can use and the Bear Prairie soil more than 10 inches. Surface runoff is slow to medium, and the hazard of erosion is slight to moderate.

This unit is used for timber (fig. 9) and wildlife habitat. Capability unit IIIe–3; woodland group 3d4; wildlife group 8.

Loper-Bear Prairie complex, 15 to 30 percent slopes (LbD).—This complex occurs as large tracts on mountainsides and hills. It is about 50 percent Loper cobbly silt loam and 40 percent Bear Prairie silt loam. Generally the thickness of the surface layer of both soils ranges from about 7 inches in the upper fourth of the slope to about 22 inches in the lower fourth.

Included in mapping are small areas where erosion has removed much or all of the original surface layer. Also included are small areas where the slope is either less than 15 percent or more than 30 percent.

Surface runoff is medium to rapid, and the hazard of erosion is moderate to severe.

This complex is used to produce timber. Capability unit IVe–2; woodland group 3d4; wildlife group 8.

Figure 9.—Road cut in Loper-Bear Prairie complex, 3 to 15 percent slopes. Areas of this mapping unit are used for timber production.

Loper-Bear Prairie complex, 30 to 50 percent slopes (LbE).—This complex occurs as large tracts on mountainsides. It is about 50 percent Loper cobbly silt loam and 40 percent Bear Prairie silt loam. Generally the thickness of the surface layer is about 7 inches, but it ranges from about 2 to 7 inches in the upper fourth of the slope to about 12 to 22 inches in the lower fourth.

Included in mapping are small areas where erosion has removed the entire original surface layer. Also included are small areas where the slope is less than 30 percent and other areas where it is more than 50 percent.

Surface runoff is very rapid, and the hazard of erosion is very severe.

This complex is used to produce timber. Capability unit VIe–1; woodland group 3d4; wildlife group 8.

Loper-Bear Prairie complex, 8 to 30 percent slopes, eroded (LbD2).—This complex occurs as large tracts on broad ridges, mountainsides, and hills. It is about 50 percent Loper cobbly silt loam and 40 percent Bear Prairie silt loam. It is similar to Loper-Bear Prairie complex, 3 to 15 percent slopes, but 50 to 75 percent of its original surface layer has been removed by erosion. Generally the surface layer is about 8 inches thick, but it ranges from 3 inches in the upper fourth of the slope to about 11 inches in the lower fourth.

Included in mapping are small areas that are only slightly eroded, small areas where the slope is either more than 30 percent or less than 8 percent, and areas where erosion has exposed the subsoil.

Surface runoff is medium to rapid, and the hazard of erosion is severe.

This complex is used to produce timber. Capability unit IVe–2; woodland group 3d4; wildlife group 8.

Made Land

Made land (Md) consists of dikes in long, narrow areas on flood plains of the major rivers. It is about 10 to 25 feet above the bottom land. The material is a mixture of poorly sorted sand, gravel, clay, and large stones. In places much of the material is sand that has been pumped in from dredging operations in the major rivers.

Made land protects the river bottom lands from seasonal flooding. It has very little value for farming. In places it is seeded to grasses and legumes for protection against erosion. Capability unit VIIIs–1; not placed in a woodland group or wildlife group.

Mart Series

The Mart series consists of well-drained soils that formed in deeply weathered, basic volcanic material on uplands. Slopes are 0 to 50 percent. The annual precipitation is 40 to 75 inches. The mean annual air temperature is about 51° F., and the frost-free season is 165 to 180 days. Elevations range from 50 to 2,000 feet.

In a representative profile, the surface layer is very dark brown and very dark grayish-brown silt loam about 7 inches thick. The subsoil, to a depth of about 42 inches, is dark-brown silty clay loam. The substratum is dark-brown very gravelly silty clay loam. The soil is slightly acid to very strongly acid throughout the profile.

Vegetation is chiefly Douglas-fir, red alder, white fir, and western redcedar and an understory of salal, cascara, ocean spray, bracken, and vine maple.

Mart soils are used primarily for timber production. Cleared areas are used for small grain, hay, and pasture.

Mart silt loam, 20 to 30 percent slopes (MrD).—This soil is in large tracts on mountainsides and in the foothills.

Representative profile of Mart silt loam, wooded, approximately 6.2 miles northeast of Woodland and 60 feet west of Little Kalama River Road. About 250 feet west and 375 feet south of the center of sec. 34, T. 6 N., R. 1 E.:

A11—0 to 2 inches, very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) when dry; weak, fine, granular structure; slightly hard, friable, nonsticky, nonplastic; many fine and medium and few coarse roots; common fine shot; few fine pebbles less than 10 millimeters in diameter; slightly acid; clear, smooth boundary. 1 to 3 inches thick.

A12—2 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) when dry; moderate, fine and very fine, subangular blocky structure; slightly hard, friable, nonsticky, nonplastic; many fine and medium and few coarse roots; common fine shot; few fine pebbles less than 10 millimeters in diameter; medium acid; clear, smooth boundary. 4 to 9 inches thick.

B1—7 to 20 inches, dark-brown (7.5YR 3/2) light silty clay loam, dark brown (10YR 4/3) when dry; moderate, fine and very fine, subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; many fine and medium roots; few fine tubular pores; few thin clay films in pores and on peds; common fine shot; few fine pebbles less than 10 millimeters in diameter; medium acid; clear, smooth boundary. 1 to 15 inches thick.

B2t—20 to 42 inches, dark-brown (7.5YR 3/2) silty clay loam, brown (7.5YR 5/2) when dry; moderate, fine, subangular blocky structure; hard, firm, sticky, plastic; common fine and medium roots to a depth of 30 inches, and few fine roots between depths of 30 and 42 inches; common fine tubular pores; few, thin, patchy clay films on peds and in pores; common fine shot; few fine pebbles 10 to 25 millimeters in diameter; strongly acid; diffuse, wavy boundary. 15 to 28 inches thick.

C—42 to 60 inches, dark-brown (7.5YR 4/2) very gravelly silty clay loam, brown (7.5YR 5/2) when dry; massive; very hard, very firm, sticky, plastic; few fine roots to a depth of 53 inches and none below; common moderately thick clay film on gravel; many angular pebbles and cobblestones ranging from 2 to 8 inches in diameter; very strongly acid.

Color of the A1 horizon ranges from 2 to 3 in value and chroma. The B1 and B2t horizons range from 2 to 4 in value and from 2 to 3 in chroma in hues of 10YR and 7.5YR. Depth to fractured and partially weathered bedrock ranges from 40 inches to more than 72 inches. The A horizon ranges from silt loam to silty clay loam and is gravelly in places. Angular gravel occurs throughout some profiles.

Included in mapping are small areas of soils that have a tough clay subsoil at a depth of about 30 inches and small areas where slopes are either more than 30 percent or less than 20 percent.

This Mart soil has moderately slow permeability and holds about 7 to 10 inches of water that plants can use. Surface runoff is medium to rapid, and the hazard of erosion is moderate to severe.

This soil is used for timber. Capability unit IVe–1; woodland group 2o3; wildlife group 7.

Mart silt loam, 0 to 8 percent slopes (MrB).—This soil is on broad ridgetops and in the low foothills.

Included in mapping are small areas where the subsoil is dark reddish brown and areas where slopes are more than 8 percent.

Surface runoff is slow, and the hazard of erosion is slight.

This soil is used to produce timber, hay, pasture, and small grain. Capability unit IIe–2; woodland group 2o3; wildlife group 4.

Mart silt loam, 8 to 20 percent slopes (MrC).—This soil is near the edges of broad ridgetops and on foothills.

Included in mapping are small areas where the subsoil is dark reddish brown and areas where the slope is either more than 20 percent or less than 8 percent.

Surface runoff is medium, and the hazard of erosion is moderate.

This soil is used to produce timber, hay, pasture, and small grain. Capability unit IIIe–1; woodland group 2o3; wildlife group 4.

Mart silt loam, 30 to 50 percent slopes (MrE).—This soil is in large tracts on mountainsides.

Included in mapping are small areas where the slope is less than 30 percent and more than 50 percent.

Surface runoff is rapid, and the hazard of erosion is severe.

This soil is used to produce timber. Capability unit VIe–1; woodland group 2r1; wildlife group 7.

McBee Series

The McBee series consists of moderately well drained soils that formed on terraces in old alluvium from shale, sandstone, and basalt material. Slopes are 0 to 3 percent. The annual precipitation is 50 to 70 inches. The mean annual air temperature is about 50° F., and the

frost-free season is 165 to 180 days. Elevations range from 275 to 450 feet.

In a representative profile, the surface layer is silty clay about 13 inches thick. It is very dark brown in the upper part and dark brown in the lower part. The upper part of the subsoil to a depth of about 27 inches is dark-brown silty clay loam; the lower part to a depth of 60 inches is brown, distinctly mottled silty clay loam. The soil is very strongly acid to medium acid throughout the profile.

The McBee soils in the Cowlitz Area have an A horizon 10 to 20 inches thick and a strongly acid or very strongly acid B horizon. These soils are outside the range defined for the series, but this difference does not alter their usefulness or behavior.

Vegetation is mixed coniferous and deciduous forest. The principal use is for woodland, but some cleared fields are used for hay and pasture.

McBee silty clay (Mb).—This soil is on terraces 20 to 70 feet above the flood plains. Tracts are moderate in size and irregular in shape. Slopes are dominantly 2 to 3 percent.

Representative profile of McBee silty clay, in woodland, about two-thirds of a mile north of Ryderwood at a point about 100 feet south of logging road, 450 feet east of State Highway No. IP and 500 feet south of the Lewis County line. About 2,250 feet west and 500 feet south of the northeast corner of sec. 3, T. 10 N., R. 3 W.:

O1—1 inch to 0, needles, twigs, leaves, and mosses in early stages of decomposition; abrupt, smooth boundary. ½ to 1½ inches thick.

A11—0 to 5 inches, very dark brown (10YR 2/2) silty clay, dark grayish brown (10YR 4/2) when dry; strong, medium, granular structure; hard, friable, sticky, very plastic; many coarse, medium, and fine roots; common fine interstitial pores; a few soft pebbles 4 to 7 millimeters in diameter; medium acid; gradual, wavy boundary. 4 to 7 inches thick.

A12—5 to 13 inches, dark-brown (10YR 3/3) silty clay, brown (10YR 5/3) when dry; moderate, medium, granular and moderate, fine, subangular blocky structure; very hard, friable, sticky, very plastic; many coarse, medium, and fine roots; common fine and few coarse tubular pores; a few soft pebbles 4 to 7 millimeters in diameter; medium acid; gradual, wavy boundary. 6 to 11 inches thick.

B21—13 to 27 inches, dark-brown (10YR 3/4) silty clay loam, yellowish brown (10YR 5/4) when dry; weak, medium, prismatic and moderate, fine, subangular blocky structure; hard, friable, sticky, plastic; few coarse and common medium and fine roots; common fine tubular pores; thin patchy clay films in pores and on peds; a few soft pebbles 4 to 7 millimeters in diameter; very strongly acid; gradual, wavy boundary. 10 to 19 inches thick.

B22—27 to 60 inches, brown (10YR 4/3) silty clay loam, light yellowish brown (10YR 6/4) when dry; weak, coarse, prismatic and moderate, fine, subangular blocky structure; hard, friable to firm, sticky, plastic; few fine and medium roots; many fine and few coarse tubular pores; thin patchy clay films in pores and on peds; a few soft pebbles 4 to 7 millimeters in diameter; many, medium, distinct, dark grayish-brown (10YR 4/2) and dark-brown (7.5YR 4/4) mottles; light yellowish brown (10YR 6/4) and yellowish brown (10YR 5/6) when dry; strongly acid.

Depth to mottles in the B2 horizon ranges from 20 to 30 inches. Where this soil is cultivated, the structure of the A1 horizon may be moderate, medium, subangular blocky.

Included in mapping are small areas where mottles are at a depth of 13 to 20 inches, areas where the slope is more than 4 percent, and small areas where the surface layer is silty clay loam or heavy silt loam. The surface layer has iron shot in some places.

This McBee soil is moderately slowly permeable and holds more than 10 inches of water that plants can use. Surface runoff is slow, and the hazard of erosion is slight. There is a seasonal water table at a depth of 2 to 5 feet.

Timber production, hay, and pasture are the principal uses of this soil. Capability unit IIw–1; woodland group 3d2; wildlife group 1.

Minniece Series

The Minniece series consists of somewhat poorly drained soils that formed on terraces in old sediment of mixed origin. Slopes are 0 to 25 percent. The annual precipitation is 50 to 60 inches. The mean annual air temperature is about 50° F., and the frost-free season is 165 to 180 days. Elevations range from 60 to 400 feet.

In a representative profile, the surface layer is very dark brown and very dark grayish-brown heavy silt loam about 13 inches thick. The subsoil is grayish-brown silty clay to a depth of 42 inches. Below a depth of 42 inches is dark grayish-brown silty clay loam. Below a depth of 13 inches, the soil is mottled and has manganese concretions and stains. It is very strongly acid to strongly acid throughout the profile.

Vegetation is mostly Douglas-fir, western redcedar, Oregon ash, red alder, vine maple, and sedges.

The soils are used mainly for woodland. The principal farm use is hay and pasture.

Minniece silt loam, 0 to 8 percent slopes (MtB).—This soil is in large tracts on terraces. Depressions are common. Slopes are dominantly 3 to 5 percent.

Representative profile of a Minniece silt loam, in woodland, in Barnes State Park, 0.2 of a mile south of the Lewis County line, 175 feet west of old U.S. Highway No. 99, and 5 miles north of junction of old U.S. Highway No. 99 and new U.S. Highway No. 99, just north of the Toutle River Bridge. 875 feet south and 670 feet west of the northeast corner of sec. 3, T. 10 N., R. 2 W.:

A11—0 to 2 inches, very dark brown (10YR 2/2) silt loam, grayish brown (10YR 5/2) when dry; moderate medium and strong, medium, granular structure; slightly hard, friable, sticky, slightly plastic; many fine, medium, and coarse roots; few fine shot; a few pebbles ½ to 1¼ inches in diameter; strongly acid; abrupt, wavy boundary. 2 to 3 inches thick.

A12—2 to 13 inches, very dark grayish-brown (10YR 3/2) heavy silt loam, grayish brown (10YR 5/2) when dry; moderate fine and moderate, medium, subangular blocky structure; hard, friable, sticky, slightly plastic; many fine, medium, and coarse roots; common medium and few coarse tubular pores; a few pebbles ½ to 1¼ inches in diameter; very strongly acid; abrupt, wavy boundary. 10 to 12 inches thick.

B21tg—13 to 20 inches, grayish-brown (2.5Y 5/2) light silty clay, light gray (2.5Y 7/2) when dry; moderate fine and moderate, medium, subangular blocky structure; hard, very firm, very sticky, plastic; common fine and medium roots; many very fine and few medium tubular pores; thin patchy clay films in pores and on peds; many, medium, distinct, strong-brown (7.5YR 5/6) and yellowish-red (5YR 5/6) mottles; common, medium, black manganese dioxide concretions and

stains; a few pebbles ½ to 1¼ inches in diameter; strongly acid; clear, wavy boundary. 7 to 9 inches thick.

B22tg—20 to 30 inches, grayish-brown (10YR 5/2) silty clay, light gray (10YR 7/2) when dry; moderate, medium, prismatic and moderate, fine, subangular blocky structure; very hard, very firm, very sticky, plastic; common fine roots; few very fine, common, medium and few coarse tubular pores; very thick continuous clay films in pores and on peds; many, medium, distinct, yellowish-red (5YR 4/8) mottles; common, medium, black manganese dioxide concretions and stains; a few pebbles ½ to 1¼ inches in diameter; strongly acid; clear, wavy bounday. 9 to 11 inches thick.

B23tg—30 to 42 inches, grayish-brown (10YR 5/2) silty clay, light gray (10YR 7/1) when dry; moderate, medium, prismatic and moderate, fine and medium, subangular blocky structure; very hard, firm, very sticky, plastic; common fine roots; very thick continuous clay films in pores and on peds; common very fine, few medium, and few coarse tubular pores; many, medium, distinct, grayish-brown (2.5Y 5/2) and strong-brown (7.5YR 5/6) mottles; few, fine, black manganese dioxide concretions and stains; a few pebbles ½ to 1¼ inches in diameter; strongly acid; abrupt, wavy boundary. 8 to 15 inches thick.

B24tg—42 to 60 inches, dark grayish-brown (10YR 4/2) heavy silty clay loam, grayish brown (10YR 5/2) when dry; moderate, coarse, prismatic and moderate, medium, subangular blocky structure; very hard, friable, sticky, plastic; few fine roots; many fine, few medium, and few very coarse tubular pores; thick, continuous, dark grayish-brown (10YR 4/2) clay film, dark brown (7.5YR 4/2) when dry; common, fine, prominent, yellowish-red (5YR 4/6) and light brownish-gray (2.5YR 6/2) mottles; a trace of black manganese dioxide stains; strongly acid; abrupt, wavy boundary. 16 to 23 inches thick.

The A1 horizon ranges from silt loam to silty clay loam. Color ranges from 2 to 3 in value and from 1 to 3 in chroma. The B2tg horizon ranges from 1 to 2 in chroma.

This soil is very slowly permeable and holds about 5 to 7 inches of water that plants can use. Surface runoff is very slow to slow, and the hazard of erosion is none to slight. A seasonal water table is commonly at a depth of 1 to 2 feet.

This soil is used mainly for timber production. Precautions should be taken to protect trees from tipover. The principal farming use is hay and pasture. Capability unit IIIw–1; woodland group 3d2; wildlife group 1.

Minniece silt loam, 8 to 25 percent slopes (MtC).—This soil is similar to Minniece silt loam, 0 to 8 percent slopes, but it has better surface drainage. In most places depth to mottles is about 25 inches.

Included in mapping are small areas of moderately well drained soils and areas where the slope is less than 8 percent.

Surface runoff is medium to rapid and the hazard of erosion is moderate to severe.

This soil is used mainly for timber production. Part of the acreage is in hay and pasture. Capability unit IVe–4; woodland group 3d2; wildlife group 3.

Minniece Series, Loamy Variant

The loamy variant of the Minniece series is a somewhat poorly drained silt loam that formed in old alluvium on terraces. Slopes are 0 to 3 percent. The annual precipitation is 50 to 60 inches. The mean annual air temperature is about 50° F., and the frost-free season is 165 to 180 days. Elevations are from 300 to 400 feet.

In a representative profile, the surface layer, about 12 inches thick, is dark-gray heavy silt loam in the upper part and gray silty clay loam in the lower part. The subsoil, to a depth of 47 inches, is gray silty clay loam and sandy clay loam. Below a depth of 47 inches the soil is grayish-brown sandy clay loam and coarse sandy loam. The soil is medium acid to strongly acid throughout the profile. Below a depth of 7 inches it is prominently and distinctly mottled.

Vegetation is Douglas-fir, Oregon ash, western redcedar, red alder, willow, and black cottonwood.

Minniece soils are used primarily for timber production, but some areas are cleared and used for hay and pasture.

Minniece silt loam, loamy variant, 0 to 3 percent slopes (MvA).—This soil occurs as moderately large tracts on terraces. Depressions are common. Slopes are dominantly 0 to 2 percent.

Representative profile of a Minniece silt loam, loamy variant, in woodland, approximately 6.4 miles northeast of Castle Rock and 165 feet east and 115 feet south on old logging spur road. About 1,700 feet south and 340 feet east of the northwest corner of sec. 9, T. 10 N., R. 1 W.:

A11g—0 to 7 inches, dark-gray (10YR 4/1) heavy silt loam, light gray (10YR 6/1) when dry; strong, fine and medium, subangular blocky structure; hard, friable, slightly sticky, slightly plastic; many fine, medium, and coarse roots; many fine interstitial pores; medium acid; clear, smooth boundary. 5 to 8 inches thick.

A12g—7 to 12 inches, gray (10YR 5/1) silty clay loam, light gray (10YR 6/1) when dry; strong, fine and medium, subangular blocky structure; hard, friable, sticky, plastic; many fine, medium, and coarse roots; common fine and few coarse tubular pores and many fine interstitial pores; common, fine, distinct, reddish-brown (5YR 4/4) mottles, strong brown (7.5YR 5/6) when dry; medium acid; clear, smooth boundary. 4 to 6 inches thick.

B21g—12 to 17 inches, gray (5Y 5/1) silty clay loam, light gray (10YR 6/1) when dry; moderate, medium, subangular blocky structure; hard, firm, sticky, plastic; common fine and medium roots; many fine and few medium tubular pores; few, thin, patchy clay films in some pores; many, medium, prominent, reddish-brown (5YR 4/4) mottles, strong brown (7.5YR 5/6) when dry; medium acid; clear, smooth boundary. 4 to 6 inches thick.

IIB22tg—17 to 37 inches, gray (5Y 5/1) light sandy clay loam, light gray (10YR 7/1) when dry; moderate, coarse, prismatic structure; hard, firm, slightly sticky, slightly plastic; few fine roots; many fine, common medium, and few coarse tubular pores; few, thin, patchy clay films in pores; many, coarse, prominent, reddish-brown (5YR 4/4) mottles, yellowish red (5YR 4/6) and red (2.5YR 4/8) when dry; strongly acid; clear, smooth boundary. 18 to 20 inches thick.

IIB23tg—37 to 47 inches, gray (5Y 5/1) sandy clay loam, light gray (10YR 6/1) when dry; moderate, coarse, prismatic and moderate, medium, subangular blocky structure; hard, firm, sticky, very plastic; few fine roots; many fine and medium tubular pores; few patchy clay films in some pores; many, medium, prominent, reddish-brown (5YR 4/4) mottles, yellowish red (5YR 4/6, 4/8) when dry; medium acid; clear, smooth boundary. 8 to 11 inches thick.

IIC1g—47 to 56 inches, grayish-brown (2.5Y 5/2) light sandy clay loam, light gray (10YR 7/2) when dry; massive; very hard, friable, sticky, nonplastic; few fine roots; common fine and few medium tubular pores; few clay films in pores; common, medium, prominent, reddish-brown (5YR 4/4) mottles, yellowish red

(5YR 5/6) and strong brown (7.5YR 5/6) when dry; strongly acid; clear, smooth boundary. 8 to 10 inches thick.

IIIC2g—56 to 62 inches, grayish-brown (2.5Y 5/2) coarse sandy loam, light brownish gray (10YR 6/2) when dry; massive; hard, very friable, nonsticky, nonplastic; few fine roots; common fine, common medium, and few coarse tubular pores and many fine interstitial pores; many, medium, distinct, dark-brown (7.5YR 4/4) mottles, yellowish red (5YR 5/6) when dry; medium acid.

In the A1 horizon value is 4 to 5 and chroma is 1 to 2. In the B horizon value is 4 to 5, chroma is 1 to 2, and hues are 5Y and 2.5Y. Mottling in the B horizon ranges from distinct to prominent. Depth to coarse sandy loam ranges from 40 to 60 inches.

Included in mapping are small areas of soils that are moderately well drained and in places free of mottles in the uppermost 12 inches. Also included are some poorly drained soils in depressions that are mottled to the surface in places.

This Minniece soil is slowly permeable and holds about 8 to 10 inches of water that plants can use. Surface runoff is very slow to slow, and there is little or no hazard of erosion.

The principal use of this soil is for timber production. Some areas have been cleared for hay and pasture. Capability unit IIIw–1; woodland group 3d2; wildlife group 3.

Newberg Series

The Newberg series consists of well-drained fine sandy loams and silt loams on flood plains of the large streams. These soils formed in mixed sediment from basic and acid igneous rocks. Slopes are 0 to 3 percent. The annual precipitation is 38 to 60 inches. The mean annual air temperature is about 52° F., and the frost-free season is 165 to 195 days. Elevations range from 10 to 50 feet.

In a representative profile, the surface layer is very dark grayish-brown fine sandy loam to a depth of about 25 inches. Below the surface layer, to a depth of 60 inches, is very dark grayish-brown and dark-brown, stratified fine sandy loam, loamy sand, and silt loam. The soil is medium acid to neutral throughout the profile.

The Newberg soils in the Cowlitz Area have an A horizon that is 20 to 28 inches thick, which is outside the range defined for the series. This difference, however, does not alter usefulness and behavior.

Vegetation is black cottonwood, Oregon white oak, bigleaf maple, Douglas-fir, willow, and native grasses.

Newberg soils are used for a variety of truck crops, and for hay, pasture, bulbs, strawberries, and cane fruit.

Newberg fine sandy loam (Ne).—This soil is on flood plains of large streams. Tracts are large and irregularly shaped. Slopes are dominantly 1 to 2 percent.

Representative profile of Newberg fine sandy loam, in a pasture, approximately 6.7 miles north of Kelso, 3.5 miles south of Castle Rock, and about one-half mile west of the old Pacific Highway. 250 feet east and 250 feet south of the center of sec. 26, T. 9 N., R. 2 W.:

Ap—0 to 5 inches, very dark grayish-brown (10YR 3/2) fine sandy loam, dark brown (10YR 4/3) when dry; moderate, medium and coarse, granular structure; slightly hard, friable, nonsticky, nonplastic; many fine and medium roots; many fine interstitial pores; medium acid; gradual, smooth boundary. 4 to 7 inches thick.

A11—5 to 13 inches, very dark grayish-brown (10YR 3/2) fine sandy loam, brown (10YR 5/3) when dry; weak very fine and weak, medium, subangular blocky structure; soft, very friable, nonsticky, nonplastic; common fine and medium roots; few fine, few medium, and few coarse tubular pores and many fine interstitial pores; neutral; clear, smooth boundary. 6 to 9 inches thick.

A12—13 to 25 inches, very dark grayish-brown (10YR 3/2) fine sandy loam, brown (10YR 5/3) when dry; massive; soft, very friable, nonsticky, nonplastic; few fine roots; few fine tubular pores and many fine interstitial pores; neutral; clear, smooth boundary. 8 to 13 inches thick.

C1—25 to 33 inches, very dark grayish-brown (10YR 3/2) stratified loamy sand and fine sand, grayish brown (10YR 5/2) when dry; single grain; loose, nonsticky, nonplastic; few fine roots; few fine tubular pores and many fine interstitial pores; few fine pumice grains; neutral; abrupt, smooth boundary. 7 to 9 inches thick.

C2—33 to 43 inches, dark-brown (10YR 3/3) light silt loam, brown (10YR 5/3) when dry; weak, medium, subangular blocky structure to massive; soft, friable, nonsticky, nonplastic; few fine roots; common fine tubular pores and many fine interstitial pores; neutral; clear, smooth boundary. 8 to 11 inches thick.

C3—43 to 60 inches, dark-browwn (10YR 3/3) fine sandy loam, brown (10YR 5/3) when dry; common, medium, faint, dark grayish-brown (10YR 4/2) and few, fine, prominent, yellowish-red (5YR 4/6) mottles; massive; soft, very friable, nonsticky, nonplastic; few fine roots to a depth of 58 inches; few very fine tubular pores and many fine interstitial pores; neutral.

Color value and chroma of the A1 horizon range from 2 to 3. Texture below the A horizon is mostly fine sandy loam, but lenses of silt loam, loamy sand, and fine sand occur at variable depths in variable thicknesses. In places, the lower part of the C horizon is free of mottles. Color of the C horizon ranges in value from 3 to 4 and in chroma from 1 to 3.

The soil is stratified and the sequence of horizons is not always the same. In places there is no mottling in the lower profile if there is no high seasonal water table.

Included in mapping are small areas where the surface layer is a silt loam or loamy sand and small areas where silt loam extends to a depth of 30 inches.

This Newberg soil has moderately rapid permeability and holds about 8 inches of water that plants can use. Surface runoff is very slow, and the hazard of erosion is none to slight. The soil is subject to flooding in a few places where it is not diked.

This soil is used for truck crops, hay, pasture, bulbs, strawberries, and cane fruit. Capability unit I–1; wildlife group 2; not placed in a woodland group.

Newberg Series, Silty Variant

The silty variant of the Newberg series is a somewhat poorly drained soil that formed in alluvium on flood plains of the Cowlitz, Columbia, Kalama and Lewis Rivers. It is an important farming soil on the bottom land near Woodland. Slopes are 0 to 3 percent. The annual precipitation is 38 to 50 inches. The mean annual air temperature is about 52° F., and the frost-free season is 165 to 190 days. Elevations are less than 25 feet.

This soil is stratified and characteristically has

very dark horizons and grayish, rock-flour horizons in irregular sequence.

In a representative profile very dark grayish-brown silt loam extends to a depth of 12 inches. It is faintly mottled in the lower part. At a depth of 12 to 15 inches is a layer of light brownish-gray silt. At a depth of 15 to 24 inches is black silt loam. Between depths of 24 to 62 inches are layers of gray, dark-gray, light brownish-gray, grayish-brown, and dark-brown loamy fine sand, sandy loam, and silt loam. All are prominently and distinctly mottled below a depth of 30 inches. The soil is strongly acid to neutral throughout the profile.

Vegetation is mostly black cottonwood.

Most of the acreage is used for truck crops, hay, and pasture.

Newberg silt loam, silty variant (Nw).—This soil is in broad irregularly shaped tracts on flood plains of the major rivers. It is usually 1 to 2 feet higher in elevation than the associated Caples silt loam. Slopes are 0 to 3 percent.

Representative profile of Newberg silt loam, silty variant, in a pasture, 75 feet north of Dike Road, 0.6 of a mile west of Interstate Highway No. 5, and about 1⅛ miles northwest of Woodland. SW¼SW¼NE¼SE¼ sec. 11, T. 5 N., R. 1. W.:

A11—0 to 4 inches, very dark grayish-brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) when dry; moderate, fine, prismatic structure; hard, friable, slightly sticky, slightly plastic; many large, medium, and fine roots; medium acid; abrupt, wavy boundary. 4 to 5 inches thick.

A12—4 to 12 inches, very dark grayish-brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) when dry; few, fine, faint mottles; moderate, medium, prismatic structure parting to moderate, fine, subangular blocky and moderate, very fine, granular; hard, firm, slightly sticky, slightly plastic; many fine and medium roots; few, fine, faint, light yellowish-brown (10YR 6/4) mottles, very pale brown (10YR 7/4) when dry; strongly acid; abrupt, wavy boundary. 4 to 9 inches thick.

IIC1—12 to 15 inches, light brownish-gray (10YR 6/2) silt, light gray (10YR 7/2) when dry; massive; slightly hard, friable, nonsticky, nonplastic; common fine and medium roots; common fine tubular pores; common, fine, distinct, strong-brown (7.5YR 5/6) mottles, strong brown (7.5YR 5/6) when dry; slightly acid; abrupt, wavy boundary. 2 to 4 inches thick.

IIIA1b—15 to 24 inches, black (10YR 2/1) silt loam, gray (10YR 5/1) when dry; strong, coarse, prismatic structure; hard, firm, slightly sticky, slightly plastic; common fine roots; common fine tubular pores; common, fine, distinct, strong-brown (7.5YR 5/6) mottles, reddish yellow (7.5YR 6/6) when dry; medium acid; abrupt, wavy boundary. 9 to 13 inches thick.

IVC1—24 to 26 inches, gray (10YR 5/1) loamy very fine sand, light gray (10YR 6/1) when dry; single grain; loose, nonsticky, nonplastic; common fine roots; 10 percent fine and medium gravel-sized fragments of volcanic ash which crush easily when moist or dry; fragments have common, fine, distinct, strong-brown (7.5YR 4/6) mottles, reddish yellow (7.5YR 6/6) on surface and interior when dry; slightly acid; abrupt, wavy boundary. ½ inch to 3 inches thick.

VC2—26 to 30 inches, dark-gray (10YR 4/1) silt loam, gray (10YR 5/1) when dry; moderate, medium, prismatic structure; hard, friable, slightly sticky, slightly plastic; common fine roots; common very fine tubular pores, and common fine vesicular pores; few, fine, faint mottles; slightly acid; clear, wavy boundary. 4 to 8 inches thick.

VIC3—30 to 41 inches, light brownish-gray (10YR 6/2) silt loam, white (10YR 8/2) when dry; moderate, coarse, prismatic structure; very hard, firm, slightly sticky, plastic; few fine roots; common fine tubular pores; common, medium, distinct, strong-brown (7.5YR 5/6, 5/8) and dark-red (2.5YR 3/6) mottles, brownish yellow (10YR 6/8), yellow (10YR 8/6), and dark red (2.5YR 3/6) when dry, number of mottles increases in lower 3 inches of horizon; neutral; abrupt, wavy boundary. 10 to 16 inches thick.

VIIC4—41 to 55 inches, grayish-brown (2.5Y 5/2) fine sandy loam, light brownish gray (10YR 6/2) when dry; massive; soft, friable, nonsticky, nonplastic; few fine roots; common medium tubular pores; many, moderate, distinct and few, coarse, distinct, dark reddish-brown (5YR 3/4) and reddish-brown (5YR 4/4) mottles, reddish brown (5YR 4/4) and brown (7.5YR 5/4) when dry; neutral; clear, wavy boundary. 13 to 18 inches thick.

VIIC5—55 to 62 inches, dark-brown (7.5YR 4/4) fine sandy loam, brown (7.5YR 5/4) when dry; massive; slightly hard, firm, nonsticky, nonplastic; few fine roots to a depth of 60 inches and none below; few fine and few coarse tubular pores; few, coarse, distinct, pale-red (2.5YR 6/2) and dark reddish-brown (2.5YR 3/4) mottles, white (2.5YR 8/2) and dark reddish brown (5YR 3/4) when dry; neutral; clear, wavy boundary. 5 to 8 inches thick.

Color of the A1 horizon ranges from 2 to 3 in value and from 1 to 2 in chroma. Gray silt loam horizons and dark organic horizons occur throughout the profile at random depths. Color of the silt loam horizons ranges in hue from 10YR to 5Y and in value from 4 to 8. Color of the dark organic horizons is black to very dark brown. In places, below a depth of 40 inches, the soil is underlain by coarse-textured material. Lenses of loamy sand or sand ½ inch to 3 inches thick occur throughout the profile.

The location of the grayish layer of silt loam and the dark-colored layer varies and in places one or more layers of each is in the profile. In places this soil is underlain by sand below a depth of 40 inches. In other places distinct mottles are visible at a depth of about 12 inches.

This soil is moderately slowly permeable and holds more than 10 inches of water that plants can use. Surface runoff is very slow, and the hazard of erosion is none to slight. There is a seasonal water table at a depth of 1 to 2 feet. Unless diked, the soil is subject to flooding.

Pasture, hay, small grain, peas, tomatoes, bulbs, corn, cabbage, carrots, and potatoes are the principal crops. Capability unit IIw–1; wildlife group 1; not placed in a woodland group.

Olequa Series

The Olequa series consists of well-drained soils that formed in old sediment derived from basalt, sandstone, and shale. These soils are on dissected terraces. Slopes are 0 to 50 percent. The annual precipitation is 50 to 60 inches. The mean annual air temperature is about 50° F., and the frost-free season is 165 to 180 days. Elevations range from 100 to 1,200 feet.

In a representative profile (fig. 10), the surface layer is very dark grayish-brown and dark-brown silt loam about 14 inches thick. The subsoil, to a depth of about 43 inches, is dark-brown silty clay loam. The substratum to a depth of 72 inches or more is grayish-brown and dark yellowish-brown silt loam. The soil is medium acid and is distinctly and prominently mottled below a depth of 20 inches.

Vegetation is Douglas-fir, red alder, western redcedar,

Figure 10.—**Profile of Olequa silt loam, 0 to 8 percent slopes. Plant roots can penetrate to a depth of more than 5 feet in this well-drained soil.**

and bigleaf maple trees and an understory of vine maple and bracken.

Olequa soils are used for timber, pasture, hay, small grain, and cane fruit.

Olequa silt loam, 0 to 8 percent slopes [OeB].—This soil occurs as small to moderate sized tracts on terraces. In most places slopes are 2 to 5 percent.

Representative profile of Olequa silt loam, in a brushy pasture, approximately 9.4 miles north of Castle Rock on West Side Highway, 450 feet east of the highway, and 150 feet south of the Lewis County line. 1,800 feet east and 150 feet south of the northwest corner of sec. 4, T. 10 N., R. 2 W.:

A11—0 to 5 inches, very dark grayish-brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) when dry; strong fine and moderate, fine, subangular blocky and moderate, fine, granular structure; slightly hard, friable, nonsticky, slightly plastic; many fine and medium roots; a few iron shot less than 8 millimeters in diameter; medium acid; clear, wavy boundary. 4 to 6 inches thick.

A12—5 to 14 inches, dark-brown (10YR 3/3) silt loam, brown (10YR 5/3) when dry; moderate very fine, moderate fine, and strong, fine, subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; many fine and medium roots; many fine and few medium tubular pores; common iron shot less than 8 millimeters in diameter; medium acid; abrupt, wavy boundary. 8 to 10 inches thick.

B21t—14 to 20 inches, dark-brown (10YR 4/3) light silty clay loam, pale brown (10YR 6/3) when dry; moderate fine and moderate, medium, subangular blocky structure; hard, friable, very sticky, plastic; common fine roots; many fine, few medium, and few coarse tubular pores; few thin clay films on peds and in pores; common medium iron shot less than 8 millimeters in diameter; medium acid; abrupt, wavy boundary. 6 to 8 inches thick.

B22t—20 to 43 inches, dark-brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) when dry; common, fine, faint and few, fine, prominent, yellowish-red (5YR 4/8) mottles, reddish yellow (7.5YR 6/6) when dry; weak, coarse, prismatic and moderate, medium and fine, subangular blocky structure; hard, firm, sticky, plastic; common fine roots to a depth of 20 to 24 inches, few fine roots at depths between 24 and 43 inches; many fine, common medium, and few coarse tubular pores; common thin clay film on peds and in pores, increasing to common moderately thick in lower part of horizon; few, fine, black manganese dioxide concretions and iron shot; medium acid; clear, wavy boundary. 21 to 26 inches thick.

C1—43 to 59 inches, grayish-brown (10YR 5/2) silt loam, light gray (10YR 7/2) when dry; common, fine, faint, dark yellowish-brown (10YR 4/4) mottles, light yellowish brown (10YR 6/4) when dry; common, medium, distinct, dark-brown (7.5YR 4/4) mottles, strong brown (7.5YR 5/6) when dry; massive; very hard, firm, slightly sticky, slightly plastic; few fine roots; common fine, common medium, and few coarse tubular pores; common thin clay films in pores; few, fine, black manganese dioxide concretions and iron shot; medium acid; clear, wavy boundary. 13 to 18 inches thick.

C2—59 to 72 inches, dark yellowish-brown (10YR 4/4) and grayish-brown (10YR 5/2) heavy silt loam, light yellowish brown (10YR 6/4) and light gray (10YR 7/2) when dry; common, fine, distinct, dark-brown (7.5YR 4/4) mottles, strong brown (7.5YR 5/6) when dry; massive; very hard, firm, slightly sticky, slightly plastic; many fine, many medium, and few coarse tubular pores; common moderately thick clay film on peds and in pores; few, fine, black (10YR 2/1) manganese concretions; medium acid.

Colors in the B horizon range from 10YR to 7.5YR in hue, from 3 to 5 in value, and from 2 to 5 in chroma. Texture in the B horizon ranges from silt loam to silty clay loam. Reaction is dominantly medium, but ranges from slightly acid to very strongly acid. In places the B horizon is slightly brittle. In places there are no mottles.

Included in mapping are small areas of soils where the slope is 8 to 20 percent, small areas of moderately well drained soils, and small areas of soils that have a very firm lower subsoil and upper substratum.

This Olequa soil has moderately slow permeability and holds more than 10 inches of water that plants can use. Surface runoff is slow, and the hazard of water erosion is slight.

This soil is used for timber production and for hay,

pasture, small grain, and cane fruits. Capability unit IIe–1; woodland group 2o2; wildlife group 2.

Olequa silt loam, 8 to 20 percent slopes (OeC).—This soil is on dissected terraces. It is similar to Olequa silt loam, 0 to 8 percent slopes, but it is generally free of mottles within a depth of 24 inches.

Included in mapping are small areas where the slope is more than 20 percent and other areas where it is less than 8 percent.

Surface runoff is medium, and the hazard of erosion is moderate.

This soil is used for timber production and for hay, pasture, small grain, and cane fruit. Capability unit IIIe–1; woodland group 2o2; wildlife group 2.

Olequa silt loam, 20 to 30 percent slopes (OeD).—This soil is on dissected terrace fronts. It resembles Olequa silt loam, 0 to 8 percent slopes, but it is generally free of mottles within a depth of 30 inches.

Included in mapping are small areas where the slope is either more than 30 percent or less than 20 percent.

Surface runoff is medium to rapid, and the hazard of erosion is moderate to severe.

This soil is used for timber production. Capability unit IVe–1; woodland group 2o2; wildlife group 7.

Olequa silt loam, 30 to 50 percent slopes (OeE).—This soil is similar to Olequa silt loam, 0 to 8 percent slopes, but it is generally free of mottles within a depth of 30 inches.

Included in mapping are small areas where the slope is either less than 30 percent or more than 50 percent.

Surface runoff is rapid; the hazard of erosion is severe.

This soil is used for timber production. Capability unit VIe–1; woodland group 2r1; wildlife group 7.

Olequa Series, Moderately Well Drained Variant

The Olequa series, moderately well drained variant, consists of silt loams that formed on the uplands in old sediment derived from basic igneous rocks overlain by windlaid material. Slopes are 3 to 15 percent. The annual precipitation is 45 to 55 inches. The mean air temperature is about 51° F., and the frost-free season is 165 to 180 days. Elevations range from 300 to 700 feet.

In a representative profile (fig. 11), the soil to a depth of about 25 inches is dark-brown and dark yellowish-brown silt loam. It is mottled below a depth of 20 inches. The subsoil is dark-brown silty clay loam to a depth of about 37 inches. At depths between 37 to 62 inches, the soil is dark-brown silty clay loam and silty clay and has many black manganese dioxide concretions and grayish-brown tongues that penetrate to a depth of about 48 inches. The soil is strongly acid throughout the profile.

Vegetation is mainly Douglas-fir, red alder, western redcedar, salmonberry, bracken, and swordfern.

The principal use of this soil is for timber, hay, pasture, and strawberries.

Olequa silt loam, moderately well drained variant, 3 to 8 percent slopes (OlB).—This soil is on broad ridgetops. Areas are large and irregular in shape. Slopes are dominantly 5 to 7 percent.

Representative profile of Olequa silt loam, moderately well drained variant, in woodland, approximately 8 miles northwest of Longview and about 75 feet north of Stella Road at a point about 0.9 mile northwest of the Stella-Wohl Road intersection. About 700 feet south and 2,600 feet east of the northwest corner of sec. 9, T. 8 N., R. 3 W.:

A11—0 to 11 inches, dark-brown (10YR 3/3) silt loam, brown (10YR 5/3) when dry; moderate, fine, granular structure and moderate, fine, subangular blocky; slightly hard, very friable, nonsticky, nonplastic; many coarse, medium, and fine roots; many fine interstitial pores; common fine iron shot; strongly acid; gradual, wavy boundary. 9 to 13 inches thick.

B21—11 to 20 inches, dark yellowish-brown (10YR 3/4) silt loam, yellowish brown (10YR 5/4) when dry; weak, fine, subangular blocky structure; soft, friable, slight-

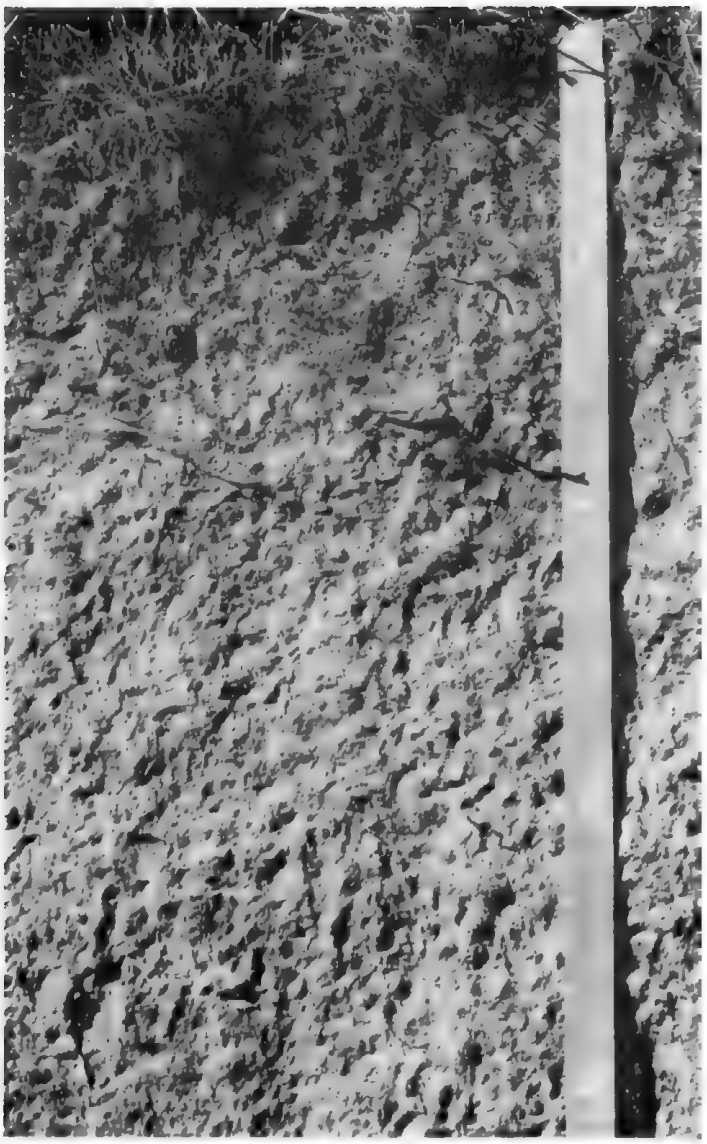

Figure 11.—**Profile of Olequa silt loam, moderately well drained variant, 3 to 8 percent slopes. Wind-laid silt loams overlie an old sedimentary deposit at a depth of about 25 inches. Prisms of the underlying soil are coated with grayish-brown and light-gray silt loam and light silty clay loam that is as much as three-fourths of an inch thick.**

ly sticky, slightly plastic; many coarse, medium, and fine roots; common fine tubular pores; common fine iron shot; very strongly acid; gradual, wavy boundary. 7 to 13 inches thick.

B22—20 to 25 inches, dark yellowish-brown (10YR 4/4) silt loam, light yellowish brown (10YR 6/4) when dry; moderate and weak, fine, subangular blocky structure; soft and slightly hard, friable, sticky, plastic; few coarse and medium and common fine roots; common fine tubular pores; common, medium, distinct, yellowish-red (5YR 5/6) and grayish-brown (10YR 5/2) mottles, reddish yellow (7.5YR 7/6) and light gray (2.5Y 7/2) when dry; few fine iron shot and few black manganese dioxide stains; strongly acid; clear, wavy boundary. 3 to 8 inches thick.

IIB&A1—25 to 37 inches, dark-brown (10YR 4/3) silty clay loam, brown (10YR 5/3) when dry; moderate, medium, prismatic and moderate, medium, subangular blocky structure; very hard, very firm, sticky, plastic; few fine roots to a depth of 37 inches, mostly in the A2 horizon; many fine and common medium tubular pores; thin continuous clay film on peds and in pores; on the prism faces are grayish-brown (2.5Y 5/2) A2 horizon silt loam coatings about 1/16 to 3/4 inch thick, light gray (2.5Y 7/2) when dry; common black manganese dioxide concretions and stains; strongly acid; irregular, wavy boundary. 9 to 15 inches thick.

IIB&A2—37 to 48 inches, dark-brown (7.5YR 3/4) heavy silty clay loam, strong brown (7.5YR 5/6) when dry; moderate, medium and coarse, prismatic and moderate, medium, angular blocky structure; very hard, very firm, slightly firmer than the IIB&A1 horizon, sticky, plastic; no roots; many fine and common medium tubular pores; thin continuous clay film on peds and in pores; prism faces are coated with grayish-brown (2.5Y 5/2) light silty clay loam, about 1/16 to 3/4 inch thick, light gray (2.5Y 7/2) when dry; many black manganese concretions and stains; strongly acid; irregular, wavy boundary. 8 to 15 inches thick.

IIB&A3—48 to 62 inches, dark-brown (7.5YR 4/4) silty clay, brown (7.5YR 5/4) when dry; moderate, medium and coarse, subangular blocky structure; very hard, very firm, slightly firmer than the IIB&A2 horizon, sticky, plastic; no roots; common fine and medium tubular pores; thick continuous clay film on peds and in pores; many black manganese dioxide concretions and stains; strongly acid.

The A1 horizon ranges in value from 2 to 3 and in chroma from 2 to 4; the hues are 7.5YR and 10YR. The B2 horizon ranges in value and chroma from 3 to 4, and hues are 7.5YR and 10YR. The IIB&A1 horizon part of the lower sequum ranges from 5YR to 10YR in hue, and the IIB&A2 horizon part from 2.5Y to 5Y. Depth to the IIB&A1 horizon ranges from 22 to 36 inches.

Included in mapping are small areas of a somewhat poorly drained soil where the very firm horizon occurs at a depth of 15 to 20 inches; areas of deep, well-drained soils; and areas where the slope is either more than 8 percent or less than 3 percent.

This Olequa soil is very slowly permeable and holds about 10 inches of water that plants can use. Surface runoff is slow, and the hazard of erosion is slight. There is a seasonal high water table at a depth of 2 to 3 feet.

This soil is used for timber production and for hay, pasture, and strawberries. Capability unit IIIe–2; woodland group 3d3; wildlife group 4.

Olequa silt loam, moderately well drained variant, 8 to 15 percent slopes (OlC).—This soil is on broad ridges and on hillsides.

Included in mapping are some small areas of somewhat poorly drained soils near the toe slopes of rolling hills. Also included are small areas where the slope is either more than 15 percent or less than 8 percent.

Surface runoff is medium, and the hazard of erosion is moderate.

This soil is used for the production of timber and for hay, pasture, and strawberries. Capability unit IIIe–2; woodland group 3d3; wildlife group 4.

Olympic Series

The Olympic series consists of well-drained soils that formed in volcanic rock material on uplands. Slopes are 0 to 50 percent. The annual precipitation is 45 to 80 inches. The mean annual air temperature is about 50° F., and the frost-free season is 165 to 180 days. Elevations range from 100 to 1,760 feet.

In a representative profile, the surface layer is dark-brown silt loam about 10 inches thick. The subsoil is dark reddish-brown and dark-brown heavy silt loam to heavy silty clay loam that extends to a depth of 48 inches. The substratum is multicolored decomposing basalt. The soil is slightly acid to strongly acid and in places is gravelly or cobbly throughout the profile.

Vegetation is mostly Douglas-fir and scattered red alder, western redcedar, western hemlock, and bigleaf maple. The understory is vine maple, swordfern, bracken, and salal.

These soils are used for timber production and for hay, pasture, small grain, strawberries, and cane fruit.

Olympic silt loam, 2 to 8 percent slopes (OmB).—This soil is on broad ridgetops and on foothills. In most places slopes are 4 to 7 percent.

Representative profile of Olympic silt loam, in a brush pasture, approximately 8 miles east of Castle Rock via the Spirit Lake Highway and the Silver Lake Road and 500 feet west of the junction of Silver Lake Road and Headquarters Road. About 125 feet south and 1,000 feet west of east quarter corner sec. 20, T. 9 N., R. 1 W.:

A11—0 to 3 inches, dark-brown (7.5YR 3/2) silt loam, dark brown (7.5YR 4/2) when dry; moderate, medium, granular structure; slightly hard, very friable, slightly sticky, slightly plastic; many fine and medium and few coarse roots; few fine shot; slightly acid; clear, wavy boundary. 2 to 4 inches thick.

A12—3 to 10 inches, dark-brown (7.5YR 3/2) silt loam, dark brown (7.5YR 4/2) when dry; moderate fine and moderate, very fine, subangular blocky structure; slightly hard, very friable, slightly sticky, slightly plastic; many fine and medium and few coarse roots; many medium shot; slightly acid; clear, wavy boundary, 6 to 9 inches thick.

B21t—10 to 20 inches, dark reddish-brown (5YR 3/3) heavy silt loam, reddish brown (5YR 3/3) when dry; strong, very fine, subangular blocky structure; slightly hard, friable, sticky, plastic; many fine and medium roots to a depth of 16 inches and common fine and medium roots at depths between 16 and 20 inches; few fine and few medium tubular pores; common thin clay films on peds and in pores; few fine shot; slightly acid; clear, wavy boundary. 8 to 11 inches thick.

B22t—20 to 27 inches, dark reddish-brown (5YR 3/4) silty clay loam, reddish brown (5YR 4/4) when dry; moderate, very fine, subangular blocky structure; hard, firm, sticky, plastic; common fine and medium roots; many fine and few medium tubular pores; many thin clay films on peds and in pores; common fine shot; medium acid; gradual, wavy boundary, 4 to 9 inches thick.

B23t—27 to 40 inches, dark-brown (7.5YR 4/4) heavy silty clay loam, dark brown (7.5YR 4/4) when dry; moderate, very fine, subangular blocky structure; hard, firm, very sticky, plastic; common fine and few medium roots; common medium and common fine tubular pores; many thin clay films on peds and in pores; few fine shot; trace of manganese dioxide stains; medium acid; gradual, wavy boundary. 10 to 15 inches thick.

B3—40 to 48 inches, dark-brown (7.5YR 4/4) heavy silt loam, yellowish brown (10YR 5/6) when dry; moderate, medium and fine, subangular blocky structure; hard, very firm, sticky, plastic; common fine roots; common fine and common medium tubular pores and few coarse vesicular pores; many moderately thick clay films on peds and in pores; many fine manganese dioxide concretions; strongly acid; abrupt, wavy boundary. 7 to 9 inches thick.

C—48 to 70 inches, multicolored decomposing basalt; few fine roots to a depth of 52 inches; few coarse vesicular pores; common moderately thick clay films around fractured basalt; many fine manganese dioxide concretions and stains; strongly acid.

The A1 horizon ranges from 10YR to 5YR in hue, from 2 to 3 in value, and from 2 to 4 in chroma. In places the A1 horizon contains a few fine shot. The B horizon ranges from 10YR to 2.5YR in hue, from 2 to 4 in value, and from 2 to 4 in chroma. In texture it ranges from heavy silt loam to silty clay. Its structure ranges from moderate to strong, from very fine to medium, and from subangular blocky to angular blocky. Shot, manganese dioxide concretions, and moderately thick to thick clay films are normally present in the lower B2 horizon. Depth to underlying bedrock ranges from 40 inches to more than 72 inches. In places rock fragments occur throughout the profile.

Included in mapping are small areas of soils where the slope is either more than 8 percent or less than 2 percent and of soils that have a gravelly silt loam surface texture.

This Olympic soil is moderately slowly permeable and holds about 10 inches of water that plants can use. Surface runoff is slow, and the hazard of erosion is slight.

This soil is used for timber, hay, pasture, small grain, strawberries, and cane fruit. Capability unit IIe–2; woodland group 2o3; wildlife group 4.

Olympic silt loam, 8 to 20 percent slopes (OmC).—This soil is on broad ridgetops and on hillsides.

Included in mapping are some small areas of moderately well drained soils near the toe slopes of rolling hills. Also included are small areas of gravelly and cobbly soils, areas where the slope is more than 20 percent, and areas where it is less than 8 percent. In addition there are very small inclusions of soils that are somewhat poorly drained and have heavy clay at an average depth of 30 inches.

Surface runoff is medium, and the hazard of erosion is moderate.

This soil is used for the production of timber and for hay, pasture, strawberries, cane fruit, and small grain. Capability unit IIIe–1; woodland group 2o3; wildlife group 4.

Olympic silt loam, 20 to 30 percent slopes (OmD).—This soil is in large, irregularly shaped tracts on mountainsides. Thickness of the surface layer ranges from about 8 inches in the upper fourth of the mountainside to about 11 inches in the lower fourth.

Included in mapping are small areas of gravelly and cobbly soils and areas where the slope is either more than 30 percent or less than 20 percent. Also included are small areas where the soil is subject to mixing by burrowing animals, especially mountain beaver. In these areas the uppermost horizon has been altered and clay films are discontinuous in the subsoil.

Surface runoff is medium to rapid, and the hazard of erosion is moderate to severe.

This soil is used for timber production. Capability unit IVe–1; woodland group 2o3; wildlife group 7.

Olympic silt loam, 30 to 50 percent slopes (OmE).—This soil is on mountainsides. Areas are large and are parallel to major drainageways. Slopes are dominantly about 40 percent. Thickness of the surface layers ranges from about 6 inches in the upper fourth of the mountainside to about 13 inches in the lower fourth.

Included in mapping are small areas of gravelly and cobbly soils and small areas where the slope is either less than 30 percent or more than 50 percent. Also included are small areas of soils that are subject to mixing by burrowing animals, especially mountain beaver. In these areas the upper horizon has been altered and clay films in the subsoil are discontinuous.

Surface runoff is rapid, and the hazard of erosion is severe.

This soil is used for timber production. Capability unit VIe–1; woodland group 2r1; wildlife group 7.

Olympic gravelly silt loam, 2 to 8 percent slopes (OpB).—This soil is on broad ridgetops and in the foothills. It is similar to Olympic silt loam, 2 to 8 percent slopes, but it is gravelly throughout the profile. The amount of gravel increases with increasing depth. In most places slopes are 4 to 7 percent.

Included in mapping are areas of soils that contain less gravel than this soil and small areas where the slope is steeper than 8 percent.

This Olympic soil holds about 8 to 10 inches of water that plants can use.

This soil is used for timber, hay, pasture, strawberries, cane fruit, and small grain. Capability unit IIe–2; woodland group 3o1; wildlife group 4.

Olympic gravelly silt loam, 8 to 20 percent slopes (OpC).—This soil is near the edge of broad ridgetops and on hillsides. It is similar to Olympic silt loam, 2 to 8 percent slopes, but it is 15 to 50 percent gravel and cobblestones. The largest amount of gravel is below a depth of 39 inches. In most places slopes are 10 to 15 percent.

Included in mapping are small areas where the slope is either more than 20 percent or less than 8 percent and small areas where the soil is relatively free of gravel.

This Olympic soil holds about 8 to 10 inches of water that plants can use. Surface runoff is medium, and the hazard of erosion is moderate.

Timber, hay, pasture, strawberries, cane fruit, and small grain are produced on this soil. Capability unit IIIe–1; woodland group 3o1; wildlife group 4.

Olympic gravelly silt loam, 20 to 30 percent slopes (OpD).—This soil is on mountainsides in large, irregularly shaped tracts. It is similar to Olympic silt loam, 2 to 8 percent slopes, but it is gravelly throughout. The thickness of the surface layer ranges from about 5 inches in the upper fourth of the mountainside to about 11 inches in the lower fourth.

Included in mapping are small areas where the slope is either more than 30 percent or less than 20 percent.

Surface runoff is medium to rapid, and the hazard of erosion is moderate to severe. The soil holds about 8 to 10 inches of water that plants can use.

This soil is used for timber production. Capability unit IVe-1; woodland group 3o1; wildlife group 7.

Olympic gravelly silt loam, 30 to 50 percent slopes (OpE).—This soil resembles Olympic silt loam, 2 to 8 percent slopes, but it is gravelly throughout. It is on mountainsides. Areas are large and are parallel to major drainageways. Thickness of the surface layer ranges from about 5 inches in the upper fourth of the mountainside to about 13 inches in the lower fourth.

Included in mapping are small areas where the slope is either less than 30 percent or more than 50 percent.

Surface runoff is rapid, and the hazard of erosion is severe. The soil holds about 8 to 10 inches of water that plants can use.

This soil is used for timber production. Capability unit VIe-1; woodland group 3r1; wildlife group 7.

Olympic cobbly silt loam, 0 to 20 percent slopes (OyC).—This soil is similar to Olympic silt loam, 2 to 8 percent slopes, but it is cobbly in the surface layer and very cobbly in the subsoil and substratum. It is on broad ridgetops and on hillsides. In most places slopes are 6 to 12 percent. Thickness of the surface layer ranges from about 8 to 11 inches.

Included in mapping are small areas where the slope is more than 20 percent.

Surface runoff is slow to medium, and the erosion hazard is slight to moderate. The soil holds 4 to 6 inches of water that plants can use.

This soil is used for timber production. Capability unit VIs-3; woodland group 3f1; wildlife group 7.

Pilchuck Series

The Pilchuck series consists of excessively drained soils that formed in alluvium derived from basic and acid volcanic rocks. Slopes are 0 to 8 percent. The annual precipitation is 38 to 60 inches. The mean annual air temperature is about 52° F., and the frost-free season is 165 to 195 days. Elevations range from 10 to 50 feet.

In a representative profile, the surface layer is very dark grayish-brown loamy fine sand and sandy loam about 5 inches thick. Below the surface layer, to a depth of more than 60 inches, is dark-gray and very dark gray medium sand. The soil is medium acid to slightly acid throughout the profile.

Vegetation is black cottonwood, bigleaf maple, willow, Scotch broom, and grasses.

These soils are used mostly for hay and pasture. In many places they are covered with brush that serves as good wildlife cover.

Pilchuck loamy fine sand, 0 to 8 percent slopes (PcB).—This soil is on flood plains of the larger streams. Areas are moderately large, are usually oblong in shape, and are mostly near the streams. Slopes are dominantly 2 to 4 percent.

Representative profile of Pilchuck loamy fine sand, in a brush pasture, approximately 7.5 miles north of Kelso and 3.75 miles south of Castle Rock. About 0.75 of a mile west of old Pacific Highway, 270 feet west of gate in line fence, 225 feet south of the cottonwood tree, and about 900 feet east and 1,660 feet south of the northwest corner of sec. 26, T. 9 N., R. 2 W.:

A11—0 to 2 inches, very dark grayish-brown (10YR 3/2) sandy loam, dark grayish brown (10YR 4/2) when dry; weak fine and moderate, very fine, subangular blocky structure; soft, very friable, nonsticky, nonplastic; many fine and medium roots; common fine tubular pores and many fine interstitial pores; medium acid; abrupt, smooth boundary. 1 to 3 inches thick.

A12—2 to 5 inches, very dark grayish-brown (10YR 3/2) loamy fine sand, dark grayish brown (10YR 4/2) when dry; single grain; loose, nonsticky, nonplastic; common fine and medium roots; many fine interstitial pores; medium acid; gradual, smooth boundary. 2 to 4 inches thick.

C1—5 to 18 inches, very dark gray (10YR 3/1) medium sand, gray (10YR 5/1) when dry; few, coarse, faint mottles; single grain; loose, nonsticky, nonplastic; few fine roots to a depth of 10 inches; many fine interstitial pores; few fine pumice grains; slightly acid; clear, smooth boundary. 12 to 15 inches thick.

C2—18 to 60 inches, dark-gray (10YR 4/1) medium sand, gray (10YR 5/1) when dry; single grain; loose, nonsticky, nonplastic; no roots; many fine interstitial pores; few fine pumice grains; slightly acid.

The A1 horizon ranges from 2 to 3 in chroma and from 1 to 3 in value. The C horizon ranges from 2 to 5 in value and from 1 to 2 in chroma. Reaction ranges from medium acid to neutral. The soil commonly becomes less acid with increasing depth. In a few places it contains stratified gravel. Varying small amounts of pumice gravel generally occur in the C horizon, but in places, some occurs in the A horizon.

Included in mapping are small areas where the surface layer is fine sandy loam, coarse sand, or silt loam.

This Pilchuck soil is very rapidly permeable and holds about 3 to 4 inches of water that plants can use. Surface runoff is very slow. Most of the acreage is protected from flooding by dikes. Unless diked, the soil is subject to damaging overflow.

The principal use of this soil is for pasture and hay. Capability unit VIs-2; wildlife group 10; not placed in a woodland group.

Riverwash

Riverwash (Rh) consists of stream deposits of poorly assorted sand, gravel, or cobblestones that are frequently overflowed and altered by erosion and deposition. It occurs as long, narrow areas along stream and river channels (fig. 12) or in recently abandoned streambeds. Some areas are barren. Others support only a scattering of cottonwood, willow, red alder, and brush. Riverwash has no value for crops. Its greatest value is for road and fill material. Capability unit VIIIw-1; wildlife group 10; not placed in a woodland group.

Rock Land

Rock land (Ro) occupies small widely scattered areas on toe slopes and hillsides. It is gently sloping and rolling to very steep. In most places it is shallow over hard bedrock, but in some it is very shallow to moderately deep. Outcrops of basalt, andesite, or sandstone are common. In some places the soil between the outcrops is very gravelly or very cobbly. In other places it is relatively free of pebbles or cobblestones in the uppermost 8 inches. Surface runoff is slow to rapid, and the

Figure 12.—Riverwash along the Cowlitz River is subject to frequent overflow. It is used as a fishing bar.

hazard of erosion is slight to severe. Rock land holds 0.5 to 2.5 inches of water that plants can use. It is used to produce timber (fig. 13). Capability unit VIIs–1; woodland group 3x1; wildlife group 6.

Rose Valley Series

The Rose Valley series consists of somewhat poorly drained soils that formed in old sediment on dissected high terraces. Slopes are 0 to 30 percent. The annual precipitation is 45 to 55 inches. The mean annual air temperature is about 51° F., and the frost-free season is 165 to 180 days. Elevations range from 40 to 300 feet.

In a representative profile, the surface layer, to a depth of 14 inches is very dark brown and dark-brown silt loam. The subsurface layer to a depth of about 30 inches is grayish-brown silty clay loam. Between depths of 30 and 62 inches is grayish-brown silty clay. The soil is mottled below a depth of 6 inches and is medium acid to slightly acid.

Vegetation is Douglas-fir, western redcedar, red alder, and bigleaf maple and an understory of sedges, vine maple, and willow.

Rose Valley soils are used for timber, pasture, and hay.

Rose Valley silt loam, 0 to 8 percent slopes (RvB).—This soil is on terraces. Areas are small to moderately large and irregular in shape.

Representative profile of Rose Valley silt loam, in woodland, approximately 5 miles southeast of Kelso in Rose Valley. About 500 feet south of the Rose Valley store and 225 feet west of Fish Pond Road, at a point about 510 feet south and 225 feet west of the north quarter corner of sec. 17, T. 7 N., R. 1 W.:

A11—0 to 6 inches, very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) when dry; moderate,

Figure 13.—Rock land. Pockets of soil between the rock outcrops extend deep enough to support trees.

medium, granular and moderate, fine, subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; many fine and medium and common coarse roots; few fine iron-manganese shot; medium acid; clear, wavy boundary, 5 to 7 inches thick.

A12—6 to 14 inches, dark-brown (10YR 3/3) silt loam, brown (10YR 5/3) when dry; moderate, fine, subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; many fine and medium and common coarse roots to a depth of 10 inches and common fine and medium and few coarse roots at depths between 10 and 14 inches; common fine tubular pores; common medium iron-manganese shot; few, fine, faint mottles; medium acid; clear, wavy boundary. 5 to 9 inches thick.

A2–14 to 30 inches, grayish-brown (10YR 5/2) silty clay loam, light gray (10YR 7/2) when dry; weak, medium, prismatic and moderate, medium, subangular blocky structure; hard, firm, sticky, very plastic; common fine and medium roots; few coarse and fine and common medium tubular pores; many, coarse, prominent, strong-brown (7.5YR 5/6) mottles, strong brown (7.5YR 5/6) and reddish yellow (7.5YR 6/6) when dry; few, fine, black manganese dioxide concretions; medium acid; abrupt, wavy boundary. 15 to 18 inches thick.

B&A—30 to 39 inches, grayish-brown (10YR 5/2) silty clay, light brownish gray (10YR 6/2) when dry; white (2.5YR 8/2) heavy silt loam coating on prism faces, ¼ inch thick coating is continuous in the upper part of the horizon and thin to patchy in the lower part, white (2.5Y 8/2) when dry; strong, medium, prismatic and moderate, medium, angular blocky structure; very hard, very firm, very sticky, very plastic; common fine and medium roots; many very fine tubular pores; many moderately thick clay films on peds and in pores; common, medium, distinct, strong-brown (7.5YR 5/6) mottles, strong brown (7.5YR 5/6) when dry; few, fine, black manganese dioxide concretions; medium acid; clear, wavy boundary, 7 to 9 inches thick.

B21tg—39 to 51 inches, grayish-brown (10YR 5/2) silty clay, light brownish gray (10YR 6/2) when dry; strong,

coarse, prismatic and moderate, medium, angular blocky structure; very hard, very firm, sticky, very plastic; few fine roots; common medium and very fine tubular pores; many moderately thick clay films on ped and in pores; many, medium, distinct, strong-brown (7.5YR 5/6) mottles, strong brown (7.5YR 5/6) when dry; few, fine, black manganese dioxide concretions; few quartzitic pebbles; medium acid; gradual, wavy boundary. 11 to 14 inches thick.

B22tg—51 to 62 inches, grayish-brown (2.5Y 5/2) silty clay, light brownish gray (2.5Y 6/2) when dry; moderate, coarse, prismatic and strong, medium, angular blocky structure; very hard, very firm, very sticky, very plastic; few fine roots to a depth of 60 inches; many fine tubular pores; many moderately thick clay films on peds and in pores; many, coarse, prominent, strong-brown (7.5YR 5/6) mottles, strong brown (7.5YR 5/6) when dry; common, fine, black manganese dioxide concretions; slightly acid.

The A1 horizon ranges from 2 to 3 in value and 2 to 4 in chroma. The Bt horizon ranges from 4 to 6 in value and 1 to 2 in chroma and has hues of 10YR and 2.5Y. In texture it ranges from silty clay loam to clay. This soil is mottled to the surface in some wet depressional areas. Mottles are mostly distinct, but in some places they are faint and in others prominent.

Included in mapping are areas of soils that have a silty clay loam surface layer and areas of soils that are steeper than 8 percent.

This Rose Valley soil is very slowly permeable and holds about 7 to 9 inches of water that plants can use. Surface runoff is slow to medium, and the hazard of erosion is slight to moderate. There is a seasonal water table at a depth of 1 to 2 feet.

This soil is used for timber, pasture, and hay. Capability unit IIIw–3; woodland group 3d1; wildlife group 1.

Rose Valley silt loam, 8 to 15 percent slopes (RvC).—This soil is on dissected terraces. It is similar to Rose Valley silt loam, 0 to 8 percent slopes, but it is steeper and the surface layer in places is only 8 to 10 inches thick and in places is gravelly. Depth to silty clay ranges from 18 to 30 inches.

Included in mapping are areas that have a surface layer of silty clay loam and small areas where the slope is more than 15 percent.

Surface water runoff is medium to rapid. When saturated, this soil is susceptible to severe erosion and slippage.

This soil is used for timber, pasture, and hay. Capability unit IVe–5; woodland group 3d1; wildlife group 1.

Rose Valley silt loam, 15 to 30 percent slopes (RvD).—This soil is on dissected terraces. It is similar to Rose Valley silt loam, 0 to 8 percent slopes, but in most places the surface layer is only 6 to 8 inches thick. The depth to silty clay is 14 to 26 inches.

Included in mapping are small areas where the slope is either more than 30 percent or less than 15 percent and areas where the surface layer is silty clay loam.

Surface runoff is rapid. This soil is susceptible to very severe erosion and to slippage.

This soil is used for timber production. Capability unit VIe–2; woodland group 3d1; wildlife group 3.

Rose Valley Series, Thin Surface Variant

The Rose Valley series, thin surface variant, consists of poorly drained soils that formed in old stream and lake sediment derived from basic igneous rock. These soils are on terraces. Slopes are 0 to 6 percent. The annual precipitation is 50 to 60 inches. The mean annual air temperature is about 50° F., and the frost-free season is 165 to 175 days. Elevations range from 480 to 550 feet.

In a representative profile, the surface layer is very dark gray and dark-gray silt loam about 10 inches thick. The subsoil is grayish-brown silty clay to a depth of about 20 inches; the lower part is grayish-brown clay that extends to a depth of 60 inches or more. The soil is medium acid to very strongly acid and is mottled between depths of 4 and 20 inches.

Vegetation is western redcedar, western hemlock, Douglas-fir, white fir, Oregon ash, willow, bracken, and sedges.

The soils are used for woodland and pasture, much of which is brushland.

Rose Valley silt loam, thin surface variant, 0 to 6 percent slopes (RyB).—This soil is on lake and stream terraces. Depressions are common. Areas are irregular in shape. Slopes are dominantly 0 to 2 percent.

Representative profile of Rose Valley silt loam, thin surface variant, in brushland, approximately 10.4 miles east of Castle Rock and 0.4 of a mile south of the intersection of Hall Road and Spirit Lake Highway. 150 feet west and 25 feet north of the southeast corner of sec. 26, T. 10 N., R. 1 W.:

A1—0 to 4 inches, very dark gray (10YR 3/1) silt loam, grayish brown (10YR 5/2) when dry; moderate medium and strong, fine, granular structure and moderate, medium, subangular blocky structure; slightly hard, very friable, slightly sticky, slightly plastic; many fine, medium, and coarse roots; strongly acid; clear, wavy boundary. 2 to 4 inches thick.

A2—4 to 10 inches, dark-gray (10YR 4/1) silt loam, light gray (10YR 6/1) when dry; few, fine, distinct, strong-brown (7.5YR 5/8) mottles, strong brown (7.5YR 5/8) when dry; moderate medium and strong, fine, subangular blocky structure; hard, friable, sticky, slightly plastic; many fine and medium roots; common coarse roots; few coarse, common medium, and many very fine tubular pores; strongly acid; abrupt, wavy boundary. 3 to 6 inches thick.

B21tg—10 to 20 inches, grayish-brown (2.5Y 5/2) silty clay, light gray (2.5Y 7/2) when dry; light brownish-gray (2.5Y 6/2) silt loam coatings ⅛ inch thick on peds, light gray (10YR 7/1) when dry; common, coarse, prominent, strong-brown (7.5YR 5/8) mottles, strong brown (7.5YR 5/8) when dry; moderate, medium, subangular blocky structure; hard, firm, sticky, plastic; few fine roots; many fine and few coarse and medium tubular pores; many thick clay films in pores; few decomposing sandstone gravels have black manganese dioxide stains forming in the center and weak iron oxide stains forming on the outer ring; medium acid; abrupt, wavy boundary 9 to 13 inches thick.

B22tg—20 to 27 inches, grayish-brown (2.5Y 5/2) clay, white (2.5Y 8/2) when dry; moderate, medium, prismatic and moderate, medium, angular blocky structure; very hard, very firm, slightly sticky, very plastic; few fine roots; many fine, common medium, and few coarse tubular pores; many thick clay films on peds and in pores; few gravels ⅛ to ¾ inch in diameter; thin gray coatings on prism surfaces; very strongly acid; gradual, wavy boundary. 6 to 9 inches thick.

B23tg—27 to 60 inches, grayish-brown (2.5Y 5/2) clay, light brownish gray (2.5Y 6/2) when dry; moderate, coarse, prismatic and moderate medium and strong, fine, angular blocky structure; very hard, very firm, slightly sticky, very plastic; few fine roots; few fine

tubular pores; continuous thick clay film on peds and in pores; common fine manganese dioxide concretions and stains; very strongly acid.

The A1 horizon ranges from 2 to 5 in value and from 1 to 2 in chroma. The B horizon is 2.5Y and 10YR in hue and ranges from 3 to 5 in value and from 1 to 2 in chroma. Mottles are faint, distinct, and prominent. The B horizon ranges from silty clay to clay; structure ranges from moderate to strong, from very fine to coarse, and from subangular blocky to angular blocky to prismatic. In places the silt loam coatings are one-sixteenth to three-sixteenths of an inch thick. In places coatings are difficult to identify because of the gleyed colors of the matrix. In some depressions the soil is mottled to the surface. Where the soil is undulating, it is free of mottles in places to a depth of 10 inches. Depth to silty clay and clay is 4 to 18 inches.

Included in mapping are small areas where the surface layer is silty clay loam and silty clay and areas of somewhat poorly drained, sloping soils.

This Rose Valley soil is very slowly permeable and holds about 4 to 6 inches of water that plants can use. Surface runoff is very slow to slow, and the hazard of erosion is none to slight. There is a seasonal high water table within a depth of 1 foot.

Timber production and pasture are the principal uses of this soil. Capability unit IVw–1; woodland group 4d1; wildlife group 3.

Sara Series

The Sara series consists of moderately well drained soils that formed in old alluvium on dissected terraces. Slopes are 0 to 30 percent. The annual precipitation is 50 to 60 inches. The mean annual air temperature is about 50° F., and the frost-free season is 165 to 175 days.

In a representative profile, the surface layer to a depth of 12 inches is very dark grayish-brown silt loam and dark-brown silty clay loam. The subsoil to a depth of about 28 inches is dark grayish-brown silty clay loam. The material below is brown or pale-brown silty clay loam, silty clay, and sandy clay. The soil is medium acid to very strongly acid throughout the profile and is prominently and distinctly mottled below a depth of 12 inches.

Vegetation is mixed coniferous and deciduous forest. Sara soils are used for timber, hay, and pasture.

Sara silt loam, 0 to 8 percent slopes (SaB).—This soil occurs as moderately large tracts. In most places slopes are 4 to 6 percent.

Representative profile of Sara silt loam, in a pasture, approximately 10.6 miles northeast of Castle Rock, about 1,000 feet southwest of the intersection of Taylor and Wiley Roads, and 250 feet west of field road. About 900 feet west and 1,440 feet north of the southeast corner of sec. 22, T. 10 N., R. 1 W.:

A1—0 to 8 inches, very dark grayish-brown (10YR 3/2) silt loam, very dark grayish brown (10YR 3/2) when dry; strong, coarse, granular structure; slightly hard, friable, nonsticky, nonplastic; many fine, medium, and coarse roots; medium acid; clear, wavy boundary. 7 to 9 inches thick.

A3—8 to 12 inches, dark-brown (10YR 3/3) light silty clay loam, grayish brown (10YR 5/2) when dry; few, fine, faint mottles; strong, fine, subangular blocky and some moderate, medium, granular structure; slightly hard, friable, sticky, slightly plastic; many fine, medium, and coarse roots; medium acid; clear, wavy boundary. 3 to 5 inches thick.

B21t—12 to 28 inches, dark grayish-brown (10YR 4/2) silty clay loam, light brownish gray (10YR 6/2) when dry; common, medium, distinct, brown (10YR 5/3) and dark yellowish-brown (10YR 4/4) mottles, very pale brown (10YR 7/3) and light yellowish brown (10YR 6/4) when dry; moderate, medium and coarse, prismatic and moderate, medium, subangular blocky structure; very hard, firm, very sticky, plastic; common fine and medium roots to a depth of 22 inches and few fine roots in the lower 6 inches; many fine and few coarse tubular pores; thin patchy clay films in pores and on peds; some are thin, light gray (10YR 7/2) when dry; silt loam coatings on ped surfaces; common, fine, black (10YR 2/1) manganese dioxide concretions and stains; strongly acid; gradual, wavy boundary. 14 to 18 inches thick.

B&A—28 to 40 inches, brown (10YR 5/3) heavy silty clay loam, yellowish brown (10YR 5/4) when dry; many, medium, prominent, yellowish-red (5YR 4/6) mottles, yellowish red (5YR 4/6) when dry; common, medium, faint, grayish-brown (10YR 5/2) and dark-brown (10YR 4/3) mottles, white (10YR 8/2) and brown (10YR 5/3) when dry; light brownish-gray (2.5Y 6/2) silt loam coatings on prism faces, white (10YR 8/2) when dry; strong, medium, prismatic and strong, medium, subangular blocky structure; hard, very firm, sticky, plastic; few fine roots; common fine and few medium tubular pores; thick patchy clay films in pores and on peds; common, medium, black (10YR 2/1) manganese dioxide concretions and stains; strongly acid; gradual, wavy boundary. 10 to 14 inches thick.

B22t—40 to 52 inches, brown (10YR 5/3) silty clay, pale brown (10YR 6/3) when dry; many, medium, prominent, yellowish-red (5YR 4/6) mottles, yellowish red (5YR 4/6) when dry; moderate, coarse and medium, prismatic and strong, medium, subangular blocky structure; very hard, firm, sticky, very plastic; few fine roots; few very fine and few medium tubular pores; many, thick, very dark grayish-brown (10YR 3/2) clay films; light brownish-gray (10YR 6/2) silt loam coatings on some ped faces, white (10YR 8/2) when dry; strongly acid; gradual, wavy boundary. 11 to 12 inches thick.

B23t—52 to 61 inches, pale-brown (10YR 6/3) sandy clay, very pale brown (10YR 8/4) when dry; many, medium, prominent, yellowish-red (5YR 5/6) mottles, yellowish red (5YR 5/6) when dry; weak, coarse, prismatic structure; hard, firm, sticky, slightly plastic; few fine roots; common fine and medium and few coarse tubular pores; common, thick, dark yellowish-brown (10YR 4/4) clay films on ped surfaces and in clay pockets that appear to be decomposed gravel; very strongly acid; abrupt, wavy boundary.

The A1 horizon ranges from 10YR to 7.5YR in hue and from 2 to 3 in chroma. The B horizon ranges from 7.5YR to 10YR in hue, from 3 to 6 in value, and from 2 to 3 in chroma. Mottles are dominantly prominent, but in places are faint or distinct; coatings range from about one-fourth to one-half of an inch thick and generally follow prism faces. The lower part of the B horizon is fine textured and ranges from sandy clay to clay. Structure in the B horizon is dominantly moderate prismatic but in places includes weak and strong grades. Subangular blocky and angular blocky structure also occurs. Soil reaction becomes more acid with increasing depth.

Included in mapping are small areas where the surface layer is silty clay loam, small areas where the slope is 8 to 15 percent, small depressions where soils are somewhat poorly drained, and areas where the soil is silty clay or clay at a depth of 28 to 40 inches.

This Sara soil is very slowly permeable and holds about 7 to 8 inches of water that plants can use. Surface runoff is very slow to slow, and the hazard of erosion is none to slight. There is a seasonal water table at a depth of 3 to 4 feet.

The principal use of this soil is for timber production. Some areas are cleared and used for hay, pasture, and strawberries. Capability unit IIIe–2; woodland group 3d2; wildlife group 1.

Sara silt loam, 8 to 15 percent slopes (SaC).—This soil is on hillsides. It has slightly better drainage than Sara silt loam, 0 to 8 percent slopes.

Included in mapping are small areas where the slope is either less than 8 percent or more than 15 percent, areas where the surface layer is silty clay loam, and small areas of seepy wet soils.

Surface runoff is medium, and the hazard of erosion is moderate.

This soil is mostly used for timber production. Some areas are cleared and used for hay and pasture. Capability unit IIIe–2; woodland group 3d2; wildlife group 1.

Sara silt loam, 15 to 30 percent slopes (SaD).—This soil is on hillsides. It is similar to Sara silt loam, 0 to 8 percent slopes, but has slightly better drainage.

Included in mapping are small areas where the slope is either less than 15 percent or more than 30 percent.

Surface runoff is rapid, and the hazard of erosion is severe.

This soil is used for timber production. Capability unit IVe–1; woodland group 3d2; wildlife group 3.

Sara silty clay loam, 0 to 8 percent slopes (ScB).—This soil is similar to Sara silt loam, 0 to 8 percent slopes, but its surface layer is silty clay loam and the depth to silty clay or clay is only 20 to 30 inches.

Included in mapping are small areas where the surface layer is silt loam and small areas where slopes are 8 to 15 percent.

The principal use of this Sara soil is for timber production. Some areas are cleared and used for hay, pasture, and strawberries. Capability unit IIIw–2; woodland group 3d2; wildlife group 1.

Sauvola Series

The Sauvola series consists of moderately well drained soils that formed in old sediment derived from basalt, quartzite, and volcanic ash. These soils are on old dissected terraces. Slopes are 0 to 30 percent. The annual precipitation is 45 to 55 inches. The mean annual air temperature is about 51° F., and the frost-free season is 165 to 180 days. Elevations range from 150 to 350 feet.

In a representative profile, the surface layer extends to a depth of 12 inches. It is very dark grayish-brown loam in the upper part and dark-brown loam in the lower part. The subsoil is dark yellowish-brown silty clay loam in the upper part and grayish-brown silty clay in the lower part. The substratum is grayish-brown gravelly sandy clay loam and very gravelly sandy loam. The soil is mottled below a depth of 19 inches. It is medium acid to very strongly acid throughout the profile.

Vegetation is Douglas-fir, red alder, western redcedar, and bigleaf maple.

These soils are used for hay, pasture, and timber.

Sauvola loam, 0 to 8 percent slopes (SlB).—This soil is on old, high terraces in irregularly shaped tracts. Slopes are dominantly 4 to 7 percent.

Representative profile of Sauvola loam, about 9 miles southeast of Kelso, approximately 2 miles north of the Rose Valley School and 200 feet south of the Rose Valley Road. 900 feet east and 200 feet south of the center of sec. 4, T. 7 N., R. 1 W.:

O1—½ inch to 0, needles, leaves, twigs, and moss; abrupt, wavy boundary. ½ to 1 inch thick.

A11—0 to 3 inches, very dark grayish-brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) when dry; moderate, medium, subangular blocky structure; very hard, firm, slightly sticky, slightly plastic; many fine, medium, and coarse roots; medium acid; clear, wavy boundary. 2 to 5 inches thick.

A12—3 to 12 inches, dark-brown (10YR 3/3) heavy loam, grayish brown (10YR 5/2) when dry; strong, fine, subangular blocky structure; very hard, friable, slightly sticky, slightly plastic; many fine and medium and common coarse roots; few gravel; medium acid; wavy boundary. 7 to 10 inches thick.

B1t—12 to 19 inches, dark yellowish-brown (10YR 3/4) silty clay loam, brown (10YR 5/3) when dry; strong, fine, subangular blocky structure; hard, friable, slightly sticky, plastic; common fine and medium roots; common very fine tubular pores; few thin clay films on peds and in pores; few gravel; medium acid; clear, wavy boundary. 4 to 9 inches thick.

B21t—19 to 22 inches, dark yellowish-brown (10YR 4/4) silty clay loam, yellowish brown (10YR 5/4) when dry; few, fine, prominent, dark reddish-brown (2.5YR 2/4) mottles; strong, fine, subangular blocky and strong, fine, angular blocky structure; very hard, firm, sticky, plastic; few fine and medium roots; few very fine tubular pores; common moderately thick clay films; few gravel; common, fine, black manganese dioxide concretions; very strongly acid; abrupt, wavy boundary. 2 to 6 inches thick.

B22tg—22 to 30 inches, grayish-brown (2.5YR 5/2) silty clay, light gray (10YR 7/2) when dry; common, fine, distinct, strong-brown (7.5YR 5/6) mottles; strong, coarse and medium, prismatic and strong, medium, angular blocky structure; extremely hard, very firm, sticky, very plastic; few fine and medium roots; few fine tubular pores; common thick clay films on peds and in pores; many, fine, black (10YR 2/1) manganese dioxide concretions; very strongly acid; abrupt, wavy boundary. 5 to 10 inches thick.

IIC1—30 to 35 inches, grayish-brown (2.5Y 5/2) gravelly sandy clay loam, white (N 8/0) when dry; common, medium, distinct, strong-brown (7.5YR 5/6), brownish-yellow (10YR 6/6), and olive (5Y 5/4) mottles; massive; very hard, extremely hard in upper inch and weakly cemented, very firm, sticky, very plastic; very few fine roots; very few fine tubular pores; continuous, thick, dark grayish-brown (10YR 4/2) clay films on gravel; many, fine, black manganese dioxide concentrations; very strongly acid; clear, wavy boundary. 2 to 6 inches thick.

IIIC2—35 to 60 inches, multicolored very gravelly sandy loam; massive; extremely hard, extremely firm, slightly sticky, nonplastic; no roots; few, fine, black manganese dioxide concretions; very strongly acid.

Hues of the A horizon are 10 YR and 7.5YR; values range from 3 to 2. Hues of the B2t horizon are 10YR and 2.5Y; values range from 4 to 5 and chromas from 2 to 6. There are generally a few pebbles throughout the profile; in places there are many pebbles in the lower part of the B2t horizon and in the C horizon. Some pebbles are well decomposed, and a few are hard. In some places the C horizon is as much as 70 percent pebbles. The surface layer has a gritty feel in places.

Included in mapping are small areas where the soils are well drained and do not have a silty clay subsoil. There are also small areas where the slope is more than 8 percent.

This Sauvola soil is slowly permeable. It holds about

7 to 8 inches of water that plants can use. Surface runoff is slow, and the hazard of erosion is slight. There is a seasonal high water table at a depth of 3 to 5 feet.

This soil is used mainly for timber production, but some areas are cleared and used for pasture and hay. Capability unit IIIe–2; woodland group 3d3; wildlife group 4.

Sauvola loam, 8 to 15 percent slopes (SlC).—This soil is on old dissected terraces. It is similar to Sauvola loam, 0 to 8 percent slopes, but its surface layer is only about 10 inches thick. Slopes are dominantly about 12 percent.

Included in mapping are small areas where the slope is either more than 15 percent or less than 8 percent.

Surface runoff is medium, and the hazard of erosion is moderate.

This soil is used mainly for timber production. Some cleared areas are used for pasture and hay. Capability unit IIIe–2; woodland group 3d3; wildlife group 4.

Sauvola loam, 15 to 30 percent slopes (SlD).—This soil is on old dissected high terraces. It is similar to Sauvola loam, 0 to 8 percent slopes, but its surface layer is only about 8 inches thick. Areas are moderate in size and irregular in shape.

Included in mapping are small areas where the slope is more than 30 percent, some where it is less than 15 percent, and others where the surface layer is silty clay loam.

Surface runoff is rapid, and the hazard of erosion is severe.

This soil is used for timber production. Capability unit IVe–1; woodland group 3d3; wildlife group 7.

Seaquest Series

The Seaquest series consists of well-drained soils that formed in old sediment laid down in brackish water, streams, and shallow lakes in the uplands. Slopes are 0 to 30 percent. The annual precipitation is 50 to 60 inches. The mean annual air temperature is about 50° F., and the frost-free season is 165 to 175 days. Elevations range from 400 to 700 feet.

In a representative profile, the surface layer is very dark-brown silt loam, about 12 inches thick. The subsoil and substratum, to a depth of 64 inches, is dark-brown and strong-brown silty clay loam and sandy clay loam. The surface layer is neutral, and the subsoil and substratum are very strongly acid.

Vegetation is Douglas-fir, red alder, bigleaf maple, and western redcedar trees and an understory of salmonberry, swordfern, elderberry, vine maple, and hazel.

These soils are used for woodland, hay, pasture, small grain, strawberries, and cane fruit.

Seaquest silt loam, 8 to 20 percent slopes (SmC).—This soil is near the edges of broad ridgetops and on hillsides. In most places slopes are 10 to 15 percent.

Representative profile of Seaquest silt loam, in woodland, in Seaquest State Park, approximately 6.3 miles northeast of Castle Rock at a point 66 feet east and 280 feet south of the northwest corner of sec. 4, T. 9 N., R. 1 W.:

A1—0 to 12 inches, very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) when dry; strong, fine, subangular blocky structure; very hard, friable, slightly sticky, nonplastic; many fine and medium and few coarse roots; few very fine tubular pores; few pebbles; neutral; abrupt, wavy boundary. 7 to 12 inches thick.

B1t—12 to 31 inches, dark-brown (7.5YR 3/2) silty clay loam, brown (10YR 5/3) when dry; weak, medium, subangular blocky structure; hard, firm, sticky, slightly plastic; common fine and medium and few coarse roots; common very fine tubular pores; common thin clay films in pores and a few on peds; few pebbles; very strongly acid; clear, wavy boundary. 18 to 21 inches thick.

B2t—31 to 47 inches, brown (7.5YR 4/4) sandy clay loam, yellowish brown (10YR 5/4) when dry; moderate, medium, prismatic structure; hard, very firm, sticky, plastic; few fine and medium roots; common very fine and few coarse tubular pores; many thin clay films in pores and on peds; moderate amount of gravel; very strongly acid; clear, wavy boundary. 11 to 17 inches thick.

C1—47 to 64 inches, strong-brown (7.5YR 5/6) sandy clay loam, brownish yellow (10YR 6/6) when dry; moderate, thick, platy structure; hard, very firm, sticky nonplastic; common very fine and few very coarse tubular pores; continuous, thick, dark-brown (7.5YR 4/2) clay films on peds and in pores; yellowish brown (10YR 5/4) when dry; few pebbles; very strongly acid; clear, wavy boundary. 16 to 19 inches thick.

The A1 horizon ranges from 2 to 3 in value and from 2 to 4 in chroma. The B2t horizon ranges from 3 to 5 in value and from 3 to 6 in chroma. Its hues are 10YR, 7.5YR, and 5YR. In places the subsoil texture ranges from silty clay loam to sandy clay. In places the C horizon has thin lenses and pockets of very fine textured material.

Included in mapping are small areas of moderately well drained soils that have a clavpan below a depth of 40 inches and small areas where the slope is either more than 20 percent or less than 8 percent.

This Seaquest soil is moderately slowly permeable and holds about 10 inches of water that plants can use. Surface runoff is medium, and the hazard of erosion is moderate.

This soil is used for timber, hay, pasture, and small grain. Capability unit IIIe–1; woodland group 2o3; wildlife group 4.

Seaquest silt loam, 0 to 8 percent slopes (SmB).—This soil is on broad ridges and in the foothills.

Included in mapping are small areas where the slope is more than 8 percent.

Surface runoff is slow, and the hazard of erosion is slight.

This soil is used mainly for timber, hay, pasture, and small grain. A small acreage is in strawberries and cane fruit. Capability unit IIe–2; woodland group 2o3; wildlife group 4.

Seaquest silt loam, 20 to 30 percent slopes (SmD).—This soil is on mountainsides and hillsides. Thickness of the surface layer ranges from about 10 inches in the upper fourth of the slope to about 14 inches in the lower fourth.

Surface runoff is medium to rapid, and the hazard of erosion is moderate to severe.

This soil is used to produce Douglas-fir. Capability unit IVe–1; woodland group 2o3; wildlife group 7.

Semiahmoo Series

The Semiahmoo series consists of very poorly drained, organic soils. These soils formed in marshes and swamps and on the borders of lakes. They are the remains of sedges, lilies, and other water-tolerant plants. Slopes are 0 to 1 percent. The annual precipitation is 38 to 60 inches.

The mean annual air temperature is about 50° F., and the frost-free season is 160 to 180 days. Elevations range from about 0 to 1,000 feet.

In a representative profile, the surface layer is dark-brown fibrous peat and muck to an average depth of 36 inches. At depths between 36 and 48 inches is olive-gray, sedimentary peat, and at depths between 48 and 84 inches is a mixture of dark-brown muck and silty clay. The soil is very strongly acid throughout the profile.

Vegetation is sedges, water lilies, and water-tolerant woody plants.

The soils are mostly covered with brush and water and are used for wildlife habitat.

Semiahmoo peat (Sp).—This soil is in depressions in marshes and swamps and in areas bordering lakes and ponds. The largest tract borders Silver Lake in the north-central part of the Cowlitz Area.

Representative profile of Semiahmoo peat, in an area approximately 5 miles east of Castle Rock in the shallow water of Silver Lake. About 2,000 feet southwest of the intersection of Paine Road and Spirit Lake Highway, about 750 feet north of Pete Moore Island, and about 1,370 feet south of Spirit Lake Highway. About 560 feet south and 340 feet west of the center of sec. 4, T. 9 N., R. 1 W.:

Oi—0 to 16 inches, dark-brown (10YR 3/3) fibrous sedge peat, dark gray (5Y 4/1) when dry; massive; hard, friable, nonsticky, nonplastic; many coarse, medium, and fine roots; very strongly acid; gradual, smooth boundary. 14 to 18 inches thick.

Oa—16 to 36 inches, dark-brown (10YR 3/3) muck, dark gray (5Y 4/1) when dry; massive; very hard, friable, nonsticky, nonplastic; common medium and coarse roots; very strongly acid; gradual, smooth boundary. 17 to 23 inches thick.

Oe—36 to 48 inches, olive-gray (5Y 4/2) sedimentary peat, very dark gray (5Y 3/1) when dry; massive; very hard, friable, nonsticky, nonplastic; few fine roots; very strongly acid; gradual, smooth boundary. 9 to 14 inches thick.

IIC2—48 to 84 inches, dark-brown (10YR 3/3) mixed muck and silty clay, dark gray (5Y 4/1) when dry; massive; very hard, friable, slightly sticky, nonplastic; no roots; very strongly acid; abrupt, smooth boundary.

Depth of the peat to the underlying mineral soil ranges from about 30 inches to many feet. The layer of sedimentary peat generally occurs only in the larger mapped areas. In places the mineral soil is clay, silty clay loam, or pumicite.

Included in mapping is one small area of soil that has a surface layer of sphagnum moss peat, sandy clay loam at a depth of 16 inches, and sandy clay at a depth of 26 inches. Also included are small areas where the peat surface layer is only about 26 inches deep over clay.

This Semiahmoo soil is moderately permeable in the upper 4 feet and slowly permeable in the lower part. Drainage generally is not feasible. Surface water ponds. There is no erosion hazard. The water table is at or near the surface most of the year.

This soil is used mainly for wildlife habitat. Capability unit VIIIw-2; wildlife group 11; not placed in a woodland group.

Sifton Series

The Sifton series consists of somewhat excessively drained soils that are underlain by sand and gravel at a depth of 20 to 40 inches. These soils formed in sediment derived from mixed volcanic rocks and ash on narrow flood plains and terraces. Slopes are 0 to 8 percent. The annual precipitation is 90 to 100 inches. The mean annual air temperature is about 48° F., and the frost-free season is 120 to 140 days. Elevations range from 400 to 4,600 feet.

In a representative profile, the surface layer is black to very dark brown gravelly loam and sandy loam to a depth of about 4 inches. The material from a depth of 21 to 60 inches is sandy gravel. The soil is medium acid to slightly acid throughout the profile.

Vegetation is Douglas-fir, red alder, and cascara trees and an understory of bracken and hazel.

Sifton soils are used for timber, hay, and pasture.

Sifton gravelly loam, 0 to 8 percent slopes (SrB).—This soil is on narrow flood plains of tributaries to the Lewis River in the southeast part of Cowlitz Area. In most places slopes are 3 to 4 percent.

Representative profile of Sifton gravelly loam, in a wooded area, approximately 1.5 miles southwest of Yale, 240 feet west of Yale-Amboy Road, and 75 feet south of Speelyai Creek at a point about 500 feet west and 250 feet north of the center of sec. 19, T. 6 N., R. 4 E.:

A11—0 to 4 inches, black (10YR 2/1) gravelly loam, dark brown (7.5YR 4/2) when dry; moderate, medium, granular structure; slightly hard, very friable, nonsticky, nonplastic; many fine, medium, and coarse roots; slightly acid; clear, wavy boundary. 3 to 6 inches thick.

A12—4 to 9 inches, very dark brown (10YR 2/2) sandy loam, dark grayish brown (10YR 4/2) when dry; weak, fine and medium, subangular blocky structure; soft, friable, nonsticky, nonplastic; many fine, medium, and coarse roots to a depth of 7 inches, common fine and medium roots between depths of 7 and 9 inches; many fine interstitial pores; moderate amount of gravel; medium acid; abrupt, wavy boundary. 5 to 8 inches thick.

A13—9 to 21 inches, dark-brown (10YR 3/3) sandy loam, brown (10YR 5/3) when dry; weak, medium and fine, subangular blocky structure; soft, very friable, nonsticky, nonplastic; common fine roots; many fine interstitial pores and few fine tubular pores; few pebbles; medium acid; abrupt, wavy boundary. 12 to 15 inches thick.

IIC—21 to 60 inches, multicolored sandy gravel.

This is a stratified water-laid soil and layer sequences are variable. The A11 and A12 horizons range from silt loam to loam, and the gravel content ranges from 5 to 50 percent. The color ranges from 2 to 3 in value from 1 to 3 in chroma and is 7.5YR or 10YR in hue. The A13 horizon ranges in value and chroma from 3 to 4, and hue is 7.5YR or 10YR. Texture ranges from fine sandy loam to coarse sandy loam, and the gravel content from 5 to 50 percent. Depth to sandy gravel ranges from 20 to 40 inches.

Included in mapping are small areas of soil that is cobbly sand throughout and of soils that have a cobbly loam surface layer. Also included are small areas where the slope is more than 8 percent. These included soils generally are steep and very steep and are on terrace fronts. Other small inclusions are soils that are silt loam or loam to a depth of about 24 inches.

This Sifton soil is rapidly permeable and holds about 2 to 4 inches of water that plants can use. Surface runoff is slow. The hazard of erosion from flooding on the flood plains is slight to moderate.

This soil is used chiefly for timber. Small acreages

are cleared and used for hay and pasture. Capability unit IVe-8; woodland group 3f1; wildlife group 5.

Snohomish Series

The Snohomish series consists of poorly drained soils. These soils formed in stratified silty, clayey, and peaty alluvium in backwaters and depressions on flood plains of the Columbia River. Slopes are 0 to 3 percent. The annual precipitation is 38 to 50 inches. The mean annual air temperature is about 52° F., and the frost-free season is 165 to 195 days. Elevations range from 10 to 550 feet.

In a representative profile, the surface layer is gray, prominently mottled silty clay loam to a depth of 15 inches. This is underlain by stratified layers of muck, silty clay, and fibrous sedge peat to a depth of 61 inches. The soil is strongly acid to slightly acid throughout the profile.

Vegetation is black cottonwood, Oregon ash, willow, sedges, skunk cabbage, and marshgrass.

Snohomish soils are used for hay, pasture, row crops, and specialty crops.

Snohomish silty clay loam (Ss).—This soil is in depressions on the flood plains of the Columbia River. It is nearly level (fig. 14).

Representative profile of Snohomish silty clay loam, in a pasture, approximately 5 miles west of Longview in the Willow Grove community, 1,000 feet north of Willow Grove and 180 feet west of the silo. About 1,500 feet west and 1,560 feet north of the southeast corner of sec. 16, T. 8 N., R. 3 W.:

Apg—0 to 6 inches, gray (5Y 5/1) silty clay loam, gray (5Y 6/1) when dry; many, fine and medium, prominent, dark-brown (7.5YR 3/4) mottles, yellowish red (5YR 5/8) when dry; moderate, medium, subangular blocky and weak, fine, granular structure; very hard, firm, slightly sticky, plastic; many fine and medium roots; few medium tubular pores; strongly acid; abrupt, smooth boundary 6 to 7 inches thick.

A1g—6 to 15 inches, gray (5Y 5/1) silty clay loam, gray (5Y 6/1) when dry; many, fine and medium, prominent, dark-brown (7.5YR 4/4) mottles, strong brown (7.5YR 5/6) when dry; common, fine, prominent,

Figure 14.—**Poorly drained Snohomish silty clay loam. Hills in background are Olympic silt loam, 20 to 30 percent slopes.**

dark reddish-brown (2.5YR 3/4) mottles, dark red (2.5YR 3/6) when dry; moderate, coarse, prismatic and moderate, medium, subangular blocky structure; very hard, firm, slightly sticky, plastic; many fine and medium roots to a depth of 10 inches, common roots at a depth of 15 inches; many very fine and common medium tubular pores; slightly acid; abrupt, smooth boundary. 9 to 11 inches thick.

IIOe1—15 to 25 inches, gray (5Y 5/1) and dark reddish-brown (5YR 2/2) peaty muck, gray (5Y 6/1) and dark grayish brown (10YR 4/2) when dry; common, fine, distinct, dark-red (2.5YR 3/6) mottles, yellowish red (5YR 4/6) when dry; massive and layered; very hard, friable, slightly sticky, nonplastic; common fine and medium roots; common coarse and common medium tubular pores lined with iron oxide deposits; occasional sand pockets 1 to 8 inches in diameter; medium acid; abrupt, smooth boundary. 9 to 11 inches thick.

IIIC1g—25 to 27 inches, gray (5Y 5/1) silty clay, light gray (2.5YR 7/2) when dry; common, fine, prominent, dark reddish-brown (2.5YR 2/4) mottles, dark red (2.5YR 3/6) and yellowish red (5YR 4/6) when dry; massive; very hard, firm, very sticky, plastic; few fine roots; common coarse tubular pores lined with iron oxide deposits; some partially decomposed plant leaves and stems; slightly acid; abrupt, smooth boundary. 1 to 3 inches thick.

IVOe2—27 to 39 inches, dark-brown (7.5YR 3/2) fibrous sedge peat, very dark grayish brown (10YR 3/2) when dry; massive and layered; very hard, friable, nonsticky, nonplastic; few fine roots; no pores; medium acid; clear, smooth boundary. 9 to 13 inches thick.

IVOa—39 to 48 inches, olive-gray (5Y 4/2) muck, grayish brown (2.5YR 5/2) when dry; massive and layered; very hard, friable, slightly sticky, slightly plastic; few fine roots; common coarse tubular pores; slightly acid; clear, smooth boundary. 8 to 9 inches thick.

IVOe3—48 to 61 inches, very dark grayish-brown (2.5Y 3/2) peaty muck, gray (N 5/0) when dry; massive and layered; hard, friable, slightly sticky, nonplastic; no roots; few coarse tubular pores; medium acid; abrupt, smooth boundary.

Depth to the peat or muck layers ranges from 14 inches to 3 or 4 feet. The mineral horizons are gleyed and range from 10YR to 5YR in hue, from 2 to 5 in value, and from 1 to 2 in chroma. Hues of the organic layers are dominantly 5Y but range from 5Y to 5YR; values range from 2 to 5, and chroma from 1 to 4. In most places mottling extends to the surface because of the high water table.

Included in mapping are small areas where the surface layer is silt loam or clay and small areas where the soil is clayey throughout the profile.

This Snohomish soil is slowly permeable and holds more than 10 inches of water that plants can use. Surface runoff is very slow, and the hazard of erosion is none to slight. In places the high water table restricts maximum growth of plant roots.

This soil is used mainly for hay and pasture. Peppermint, beans, peas, corn, cucumbers, and other vegetables are also grown. Capability unit IIw–1; wildlife group 1; not placed in a woodland group.

Speelyai Series

The Speelyai series consists of somewhat excessively drained soils that formed in glacial outwash on terraces. Slopes are 0 to 60 percent. The annual precipitation is 55 to 70 inches. The mean annual air temperature is about 49° F., and the frost-free season is 160 to 180 days. Elevations range from 400 to 600 feet.

In a representative profile, the surface layer is loamy sand and gravelly sand to a depth of about 5 inches. The upper part of the surface layer is very dark gray; the lower part is dark gray. Beneath this and extending to a depth of about 11 inches is gray gravelly sand. This is underlain by gray, weakly cemented very gravelly sand that restricts the downward movement of water and roots. The soil is neutral to very strongly acid throughout the profile.

Vegetation is Douglas-fir, bigleaf maple, red alder, and western redcedar trees and an understory of brushy plants.

These soils are used principally for woodland, but some areas are cleared and used for pasture and hay.

Speelyai gravelly loamy sand, 0 to 8 percent slopes (SyB).—This soil is in irregularly shaped tracts on terraces. In most places slopes are 2 to 5 percent.

Representative profile of Speelyai gravelly loamy sand, in a wooded area, 150 feet northeast of South Toutle Road in a cut bank on the right side of the entrance to a large gravel pit. About 0.6 of a mile east of the school and 0.15 of a mile southeast of the Spirit Lake Highway and South Toutle Road junction. 500 feet east and 620 feet south of the center sec. 30, T. 10 N., R. 1 E.:

A11—0 to 2 inches, very dark gray (10YR 3/1) loamy sand, dark gray (10YR 4/1) when dry; single grain; loose, nonsticky, nonplastic; many fine and medium roots; neutral; abrupt, smooth boundary. ½ to 2 inches thick.

A12—2 to 5 inches dark-gray (10YR 4/1) gravelly loamy sand, light brownish gray (10YR 6/2) when dry; single grain; loose, nonsticky, nonplastic; many fine and medium roots; very strongly acid; clear, smooth boundary. 3 to 4 inches thick.

C1—5 to 11 inches, gray (10YR 5/1) gravelly sand, light gray or gray (10YR 6/1) when dry; single grain; loose, nonsticky, nonplastic; common fine roots; medium acid; clear, smooth boundary. 6 to 8 inches thick.

C2—11 to 60 inches, gray (N 5/0) weakly cemented very gravelly sand, light gray (N 7/0) when dry; massive; extremely hard and extremely firm in place, nonsticky, nonplastic; common fine roots in the upper 3 inches, few fine roots between depths of 3 and 30 inches and none below; medium acid.

Color of the A horizon ranges in value from 3 to 4 and in chroma from 1 to 3. Texture ranges from gravelly loamy sand to sandy loam. In the C horizon the color ranges in value from 4 to 5 and chroma from 0 to 2. Depth to the weakly cemented layer ranges from 9 to 20 inches. Gravel content in the A horizon ranges from 3 to 20 percent.

This soil is slowly permeable, and holds about 1 inch of water that plants can use. Surface runoff is very slow, and the hazard of erosion is none to slight.

Small areas of this soil are used for pasture and hay. Large areas are in brush or are wooded (fig. 15). Capability unit VIs–4; woodland group 5d1; wildlife group 9.

Speelyai gravelly loamy sand, 15 to 60 percent slopes (SyE).—This soil is on terrace fronts. Depth to the weakly cemented gravel layer averages about 9 inches. Slopes are dominantly 25 to 40 percent.

Surface runoff is medium to very rapid, and the hazard of erosion is moderate to severe.

This soil is used chiefly for woodland. Capability unit VIs–1; woodland group 5d1; wildlife group 9.

Figure 15.—Speelyai gravelly loamy sand, 0 to 8 percent slopes. Few roots can penetrate deeper than about 14 inches because of the extremely firm, weakly cemented very gravelly sand.

Toutle Series

The Toutle series consists of excessively drained soils that formed in alluvium high in pumice. These soils are on flood plains and terraces. Slopes are 0 to 45 percent. The annual precipitation is 38 to 70 inches. The mean annual air temperature is about 50°F., and the frost-free season is 160 to 195 days. Elevations range from 15 to 700 feet.

In a representative profile, the surface layer is very dark grayish-brown loamy sand about 12 inches thick. Below this to a depth of about 36 inches is very dark grayish-brown stratified loamy sand, sandy loam, and very fine sandy loam. The substratum, to a depth of 60 inches or more, is multicolored gravelly medium sand. The soil has neutral reaction throughout the profile. In places the surface layer is fine sandy loam. In other places the soil is gravelly loamy sand throughout the profile.

Vegetation is Douglas-fir, red alder, western redcedar, Oregon white oak, lodgepole pine, black cottonwood, bigleaf maple, and western hemlock trees and an understory of vine maple, swordfern, and bracken.

The soils are used principally for timber production. A small acreage is used for pasture.

Toutle loamy sand, 0 to 8 percent slopes (ToB).—This soil is in long, narrow areas on flood plains and in large, irregularly shaped tracts on terraces. Generally, slopes are 2 to 3 percent.

Representative profile of Toutle loamy sand, in a pasture, approximately 0.6 mile south of Woodland and 250 feet south of the junction of Pekin South Road and Whelan Road. About 875 feet west and 1,500 feet south of the northeast corner of sec. 25, T. 5 N., R. 1 E.:

A1—0 to 12 inches, very dark grayish-brown (10YR 3/2) loamy sand, brown (10YR 5/3) when dry; single grain; loose, nonsticky, nonplastic; many fine and medium roots; few pumice pebbles; neutral; abrupt, wavy boundary. 10 to 12 inches thick.

C1—12 to 36 inches, very dark grayish-brown (2.5Y 3/2) stratified loamy sand, sandy loams, and very fine sandy loam, light brownish gray (2.5Y 6/2) when dry; single grain; loose, nonsticky, nonplastic; few fine roots; a moderate amount of pumice gravel; neutral; abrupt, wavy boundary. 13 to 24 inches thick.

C2—36 to 60 inches, multicolored gravelly medium sand, dominantly dark gray (10YR 4/1) and light gray (10YR 6/1) when dry; has pockets of gravelly sand; single grain; loose, nonsticky, nonplastic; no roots; gravel is dominantly of pumice; neutral.

The A1 horizon color ranges in value from 2 to 3 and in chroma from 1 to 3; hue is 10YR or 2.5Y. The C horizon is mostly loamy sand, or coarser, stratified with lenses that are one-half inch to 3 inches thick of fine sandy loam or very fine sandy loam. Gravel content throughout the profile ranges from about 5 to 50 percent. Reaction ranges from strongly acid to neutral but generally is neutral. Normally the soil becomes slightly less acid with increasing depth.

Included in mapping are small areas where the surface layer is gravelly or is fine sandy loam and small areas where the slope is more than 8 percent.

This Toutle soil is rapidly permeable and holds about 4 inches of water that plants can use. Surface runoff is slow to very slow. Most of the acreage is protected by dikes. Unprotected areas are subject to damaging overflow.

This soil is used principally for timber production. A small acreage is used for pasture. Capability unit VIs–2; woodland group 3s1; wildlife group 9.

Toutle loamy sand, 8 to 40 percent slopes (ToD).—This soil is on terraces and terrace fronts. It is similar to Toutle loamy sand, 0 to 8 percent slopes, but it is not subject to flooding. Slopes are dominantly about 25 percent.

Included in mapping are small areas where the slope is either more than 40 percent or less than 8 percent and small areas where the surface layer is fine sandy loam or gravelly loamy sand.

Surface runoff is slow to medium, and the hazard of erosion is moderate to severe.

This soil is used for timber production. Capability unit VIs 1; woodland group 3s1; wildlife group 9.

Toutle gravelly loamy sand, 0 to 8 percent slopes (TtB).—This soil is in long, narrow tracts on flood plains and in small, irregularly shaped tracts on terraces. It is similar to Toutle loamy sand, 0 to 8 percent slopes, but it is gravelly throughout the profile and holds only about 3 inches of water that plants can use.

Included in mapping are small areas of soils that have a loamy sand surface layer, small areas where the slope is more than 8 percent, and others where the soil has cobblestones throughout the profile.

Most of the acreage is subject to flooding.

This soil is used for timber production. Capability unit VIs–2; woodland group 3s1; wildlife group 9.

Toutle fine sandy loam, 0 to 8 percent slopes (TuB).—This soil is on terraces. Except for texture of the surface layer, it is similar to Toutle loamy sand, 0 to 8 percent slopes.

Included in mapping are small areas of soils that have cemented sand or gravel in the subsoil and small areas of undulating or steep soils.

Most of the acreage is above the high water line and is not subject to flooding.

Timber production is the major use. Small acreages are used for hay and pasture. Capability unit VIs–2; woodland group 3s1; wildlife group 9.

Toutle fine sandy loam, 15 to 45 percent slopes (TuD).—Except for texture of the surface layer, this soil is similar to Toutle loamy sand, 0 to 8 percent slopes.

Included in mapping are small areas of soils that have cemented sand or gravel in the subsoil and small areas where the slope is less than 15 percent.

Surface runoff is slow to medium, and the hazard of erosion is moderate to severe.

Timber production is the major use for this soil. Capability unit VIe–3; woodland group 3s1; wildlife group 9.

Vader Series

The Vader series consists of somewhat excessively drained soils on uplands. These soils formed in material weathered from sandstone. Slopes are 8 to 50 percent. The annual precipitation is 50 to 70 inches. The mean air temperature is about 47° F., and the frost-free season is 130 to 150 days. Elevations range from 50 to 1,700 feet.

In a representative profile, the surface layer is dark reddish-brown loam about 6 inches thick. The subsoil, to a depth of 27 inches, is reddish-brown loam. The substratum is yellowish-brown loamy fine sand and very gravelly fine sand to a depth of 68 inches or more. The soil is strongly acid to very strongly acid throughout the profile.

Vegetation is Douglas-fir, western hemlock, red alder, and western redcedar trees and an understory of huckleberry, bracken and swordfern, salal, Oregon-grape, and native grasses.

Vader soils are used for timber production.

Vader loam, 30 to 50 percent slopes (VaE).—This soil is in large tracts in the northwestern part of the Area. Slopes are long and in most places are 40 to 50 percent.

Representative profile of Vader loam, in a wooded area, approximately 18 miles north of Stella, at a point 600 feet east and 1,100 feet north of the west quarter corner of sec. 13, T. 10 N., R. 4 W.:

A1—0 to 6 inches, dark reddish-brown (5YR 3/4) loam, dark brown (7.5YR 4/4) when dry; moderate, medium, granular and weak, fine, subangular blocky structure; soft, friable, nonsticky, nonplastic; many fine, medium, and coarse roots; about 12 percent is sandstone fragments 2 millimeters to 3 inches in diameter, dominantly 2 to 10 millimeters in diameter; strongly acid; gradual, wavy boundary. 2 to 8 inches thick.

B2—6 to 27 inches, reddish-brown (5YR 4/4) loam, reddish brown (5YR 5/4) when dry, about 5 percent is dark brown (7.5YR 4/4) and reddish yellow (7.5YR 6/6) when dry; weak, medium and fine, subangular blocky structure; slightly hard, friable, slightly sticky, nonplastic; many fine, medium, and coarse roots; few fine tubular pores; about 10 percent is sandstone fragments 2 millimeters to 3 inches in diameter, dominantly 2 to 10 millimeters in diameter; very strongly acid; clear, wavy boundary. 18 to 25 inches thick.

C1—27 to 54 inches, yellowish-brown (10YR 5/4) loamy fine sand, very pale brown (10YR 7/4) when dry, about 10 percent is reddish brown (5YR 4/4) or yellowish red (5YR 5/6) when dry; massive; soft, very friable, nonsticky, nonplastic; few fine roots; few fine tubular pores; about 5 percent is sandstone fragments

2 millimeters to 3 inches in diameter, dominantly 5 to 15 millimeters in diameter; very strongly acid; gradual, wavy boundary. 22 to 33 inches thick.

C2—54 to 68 inches, yellowish-brown (10YR 5/4) very gravelly fine sand, very pale brown (10YR 7/4) when dry; about 5 percent is yellowish red (5YR 4/6) or reddish yellow (5YR 6/6) when dry; massive; hard, firm, nonsticky, nonplastic; very few fine roots at a depth of 60 inches; very few fine tubular pores; about 75 percent sandstone fragments; strongly acid.

Color value of the A1 horizon ranges from 2 to 4 and chroma from 1 to 4; hue is 10YR, 7.5YR or 5YR. Color of the B and C horizons ranges in value from 4 to 5 and in chroma from 4 to 6. Depth to sandstone ranges from 40 inches to more than 72 inches. The A horizon is as thin as 2 inches on the upper fourth of long slopes and as thick as 8 inches on the lower fourth.

Included in mapping are spots of sandstone outcrop, small areas where the slope is less than 30 percent, others where it is more than 50 percent, and small areas of soils that have a silt loam or silty clay loam subsoil. Also included are small areas of soils that have a silt loam or fine sandy loam surface layer.

Permeability is moderately rapid to a depth of 27 inches and rapid below that depth. Roots penetrate as far down as bedrock. The soil holds about 6 inches of water that plants can use. Surface runoff is rapid, and the hazard of erosion is severe.

This soil is used to produce timber. Capability unit VIe–1; woodland group 2r1; wildlife group 8.

Vader loam, 8 to 30 percent slopes (VaD).—This soil is on narrow ridges and on mountainsides. It is similar to Vader loam, 30 to 50 percent slopes, but has a thicker surface layer. Thickness averages about 12 inches but ranges from about 5 inches on the upper fourth of the slope to about 15 inches on the lower fourth. In small areas, erosion has removed the entire original surface layer. There are also small areas of slippage.

Included in mapping are small areas where the surface layer is about 7 inches thick, areas that have a silt loam or silty clay loam subsoil, small areas where the slope is less than 8 percent, and areas where it is more than 30 percent.

Surface runoff is slow to medium, and the hazard of erosion is slight to severe. The soil holds about 7 inches of water that plants can use.

This soil is used for timber production. Capability unit IVe–2; woodland group 2o3; wildlife group 8.

Use and Management of the Soils

This section explains the capability classification system used by the Soil Conservation Service, describes use and management of the soils in the Cowlitz Area, and gives estimated yields of the principal crops. It also describes use and management of the soils for woodland and wildlife habitat and for engineering and town and country planning.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The groups are made according to the limitations of the soils when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for forest trees, or for engineering.

In the capability system, all kinds of soil are grouped at three levels: the capability class, the subclass, and the unit. These levels are described in the following paragraphs.

Capability Classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture or range, woodland, or wildlife habitat. (None in this survey area)

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife habitat.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture, woodland, or wildlife habitat.

Class VIII soils and landforms have limitations that preclude their use for commercial crop production and restrict their use to recreation, wildlife habitat, or water supply, or to esthetic purposes.

Capability Subclasses are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain,

at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture or range, woodland, wildlife habitat, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe–3 or IIIe–4. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

Management by capability units

The soils in the Cowlitz Area have been assigned to 35 capability units. The soils in each unit have about the same limitations, are subject to similar risks of damage, need about the same management, and respond to management in about the same way. In the following pages the capability units in the survey area are described, and suggestions for the use and management of the soils are given. To determine the soils in a capability unit, refer to the "Guide to Mapping Units" at the back of this publication.

CAPABILITY UNIT I–1

This unit consists of very deep, well-drained soils on flood plains. Slopes are 0 to 3 percent. These soils hold about 8 inches to more than 10 inches of water that plants can use. Permeability is moderate and moderately rapid. Surface runoff is very slow, and the hazard of erosion is none to slight. In areas trampled by livestock or cultivated, a compacted layer, or pan, tends to form just below the surface. The pan reduces the rate at which water and roots penetrate the soil.

All climatically adapted crops that require good drainage grow well on these soils. Suitable crops are bulbs, carrots, sweet corn, field corn for silage, potatoes, cabbage (fig. 16), broccoli, canning peas, green beans, strawberries, mint, cane fruit, pasture and hay plants, tree fruit, and nuts. Suitable grasses are orchardgrass, tall fescue, and ryegrass. Suitable legumes are alfalfa, white clover, and red clover.

These soils are among the easiest to manage in the Cowlitz Area. The pan can be corrected by varying the depth of tillage and by not pasturing or tilling when the soil is too wet. The supply of organic matter can be maintained by applying barnyard manure, by returning all crop residue to the soil, by growing green-manure crops in the rotation, and by growing soil conserving crops, such as grasses and legumes, about 1 year in 4.

Most crops respond to a complete commercial fertilizer that contains nitrogen, phosphorus, and potassium. For alfalfa, lime and boron are also needed. Supplemental sprinkler irrigation is used by many farmers but is not essential to the growth of crops. The interval between irrigations can be determined by frequent checks of soil moisture in the field.

CAPABILITY UNIT IIe–1

In this unit are well-drained soils on terraces. Slopes are 0 to 8 percent. Permeability is moderate and moderately slow. These soils hold 10 inches or more of water that plants can use. Surface runoff is slow, and the hazard of erosion is slight. In areas trampled by livestock or cultivated, a compacted layer, or pan, forms just below the surface. The pan reduces the rate at which water and roots penetrate the soil.

Most of the crops adapted to the climate of the Area can be grown on these soils. They include pasture (fig. 17), hay, bulbs, small grain, strawberries, cane fruit, truck crops, tree fruit, and nuts. Suitable grasses are orchardgrass, tall fescue, and ryegrass. Suitable legumes are alfalfa, red clover, birdsfoot trefoil, and white clover.

These soils can be cultivated throughout a wide range of moisture content. The compacted subsurface layer can be broken and better water and root penetration established by varying the depth of tillage and by preventing livestock trampling when the soil is wet. A suitable level of organic matter can be maintained by applying manure, by growing green-manure crops, and by growing soil conserving crops, such as grasses and legumes, about 1 year in 3. Soils steeper than 3 percent should be tilled across the slope to help control erosion.

Crops respond to a complete commercial fertilizer that contains nitrogen, phosphorus, and potassium. Sulfur and boron are useful to legumes and some truck and nut crops. Lime is needed for red clover, birdsfoot trefoil, white clover, and alfalfa.

Supplemental sprinkler irrigation is beneficial to crops. Intervals between irrigations can be determined by frequent checks of soil moisture in the field.

CAPABILITY UNIT IIe–2

Well-drained soils on uplands are in this unit. Slopes are 0 to 8 percent. These soils hold 7 to more than 10 inches of water that plants can use. Permeability is moderate to slow. Surface runoff is slow, and the hazard of erosion is slight. If these soils are cultivated or are trampled by livestock, a compacted layer, or pan, tends to form just below the surface. The pan reduces the rate at which water and roots penetrate the soil.

These soils are used mainly for pasture and hay, but they can also produce strawberries, cane fruit, small grain, and potatoes. Suitable grasses are orchardgrass, tall fescue, ryegrass, and timothy. Suitable legumes are red clover, white clover, subclover, and birdsfoot trefoil.

The pan can be corrected by varying the depth of the tillage, by not tilling when the soil is too wet, and by protecting it from livestock trampling when it is wet. Good tilth and an adequate supply of organic matter can be maintained by applying barnyard manure, by growing green-manure crops, and by growing soil conserving crops about half the time. Soils steeper than 3 percent should be tilled across the slope to help control erosion.

Nonlegumes respond to nitrogen fertilizer. Most crops respond to applications of phosphorus. Legumes and

Figure 16.—Harvesting cabbage on Clato silt loam. This soil has no major limitations to crop growth and management. Capability unit I–1.

high-yielding irrigated crops respond to applications of agricultural lime.

Sprinkler irrigation is beneficial but not essential to the growth of crops.

CAPABILITY UNIT IIe–3

Only Kelso silt loam, 0 to 8 percent slopes, is in this unit. This is a moderately well drained soil on terraces. Permeability is slow. The soil holds more than 10 inches of water that plants can use. Surface runoff is slow to medium, and there is a slight to moderate erosion hazard. In areas trampled by livestock or cultivated, a compacted layer, or pan, tends to develop just below the surface when the soil is wet. The pan reduces the rate at which roots and water penetrate the soil.

The principal crops grown on this soil are hay and pasture plants, strawberries, cane fruit, and small grain. Most truck crops can be grown. Suitable grasses are orchardgrass, tall fescue, ryegrass, and timothy. Suitable clovers are red clover, white clover, alsike clover, and birdsfoot trefoil.

In some places it may be necessary to install open drains or random tile lines to drain excess water from basins, potholes, or seep areas. Land smoothing and sloping improve surface drainage.

The pan can be corrected by varying the depth of tillage and by not pasturing or tilling when the soil is too wet. The supply of organic matter can be maintained by applying barnyard manure, by growing green-manure crops, and by growing soil conserving crops, such as grasses and legumes, about half the time. Soils steeper than 3 percent should be tilled across the slope to help control erosion.

Nonlegumes respond to nitrogen. Most crops respond

Figure 17.—Pasture on Olequa silt loam, 0 to 8 percent slopes. Capability unit IIe–1.

to applications of phosphorus. Legumes and high-yielding crops under irrigation respond to applications of agricultural lime.

Sprinkler irrigation is beneficial but not essential to the growth of crops. To determine the interval between irrigations, frequent checks of moisture in the field are helpful.

CAPABILITY UNIT IIw–1

This unit is made up of moderately well drained to poorly drained soils on flood plains and terraces. Slopes are 0 to 3 percent. Permeability ranges from slow to moderately slow. The soils hold 9 to more than 10 inches of water that plants can use. Surface runoff is very slow or slow, and the hazard of erosion is none to slight. In areas trampled by livestock or cultivated, a compacted layer or pan tends to form just below the surface. The pan reduces the rate at which water and roots penetrate the soil.

In undrained areas these soils are suited only to wet-tolerant grasses and legumes. If drained, they are suited to a wide variety of crops, including bulbs, sweet corn, field corn for silage, carrots, potatoes, cabbage, broccoli, canning peas, green beans, strawberries, mint, cane fruit, and pasture and hay plants. Suitable grasses for drained soils are orchardgrass, tall fescue, ryegrass, timothy, and meadow foxtail. Suitable legumes for drained soils are white clover, big trefoil, birdsfoot trefoil, red clover, alsike clover, and alfalfa.

Drainage is fairly easy to establish on these soils. Open drains or tile drains are the most satisfactory. Distance between drains determines what crops can be grown. Even though a separate drainage system must be designed for each site, generally a spacing of 400 to 600 feet between drains is adequate for all crops but those least tolerant of wetness, and a spacing of about 200 to 400 feet is adequate for all climatically adapted crops. In many places, tile lines that drain excess water from basins or potholes into outlets are needed. Land smoothing and sloping also are needed.

Pans can be corrected by varying the depth of tillage and by not pasturing or tilling when the soil is too wet. The supply of organic matter can be maintained by applying barnyard manure and by growing soil conserving crops, such as grasses and legumes, about 1 year in 4.

Most crops respond to a complete commercial fertilizer

containing nitrogen, phosphorus, and potassium. Lime is beneficial to red clover, birdsfoot trefoil, white clover, and alfalfa if the soil pH is 5.6 or lower. Sulfur and boron are needed for legumes and some truck crops.

Sprinkler irrigation is beneficial and is used by many farmers, but it is not essential to the growth of crops. Frequent checks of soil moisture in the field are helpful in determining the interval between irrigations.

CAPABILITY UNIT IIw–2

Clato silt loam, coarse variant, a well-drained soil on flood plains, is the only soil in this unit. It is moderately deep over sand and gravel. It is moderately permeable to a depth of 20 to 36 inches and very rapidly permeable below that depth. It holds about 7 inches of water that plants can use. Slopes are 0 to 3 percent. Surface runoff is slow, and there is a slight to moderate erosion hazard from floodwater. In areas trampled by livestock or cultivated, a compacted layer, or pan, tends to develop just below the surface. The pan reduces the rate at which water and roots penetrate the soil.

Pasture and hay are the principal crops, but cane fruit and strawberries can be grown in areas not subject to flooding. Small grain and truck crops can also be grown, but the soil should be protected from flooding by winter cover crops. Suitable grasses are orchardgrass, tall fescue, and ryegrass. Suitable legumes are alfalfa, white clover, and red clover.

The compacted layer can be corrected by varying the depth of tillage, tilling only when the soil is not wet, and by protecting it from livestock trampling when wet. A suitable level of organic matter can be maintained by applying barnyard manure, by growing green-manure crops, and by growing soil conserving crops about half the time.

Nonlegumes respond to nitrogen fertilizer. Most crops respond to applications of phosphorus. Legumes and high-yielding crops under irrigation respond to applications of agricultural lime.

Sprinkler irrigation from adjacent streams or wells is beneficial. Frequent checks of soil moisture in the field are helpful in determining the interval between irrigations.

CAPABILITY UNIT IIIe–1

This unit consists of well-drained soils on uplands. Slopes are 8 to 20 percent. Permeability is moderate to slow. These soils hold 7 to more than 10 inches of water that plants can use. Surface runoff is medium, and the erosion hazard is moderate. In areas trampled by livestock or cultivated, a compacted layer, or pan, tends to form just below the surface when the soils are wet. The pan reduces the rate at which water and roots penetrate the soil.

The principal crops are hay and pasture plants, but strawberries, cane fruit, and small grain are also grown. Suitable grasses are orchardgrass, tall fescue, ryegrass, and timothy. Suitable legumes are red clover, white clover, subclover, and birdsfoot trefoil.

The compacted layer can be corrected by varying the depth of tillage and by not tilling or pasturing the soil when wet. Tilling across the slopes will help control erosion. A suitable level of organic matter can be maintained by applying barnyard manure, by growing green-manure crops in the rotation, and by growing soil conserving crops, such as grasses and legumes, about half the time.

Crops respond to applications of commercial fertilizer. Nonlegumes respond to nitrogen fertilizer. Most crops respond to application of phosphorus. Legumes and high-yielding crops under irrigation respond to applications of agricultural lime.

Sprinkler irrigation is beneficial but is not essential to the growth of crops. Frequent checks of moisture in the field are helpful in determining the interval between irrigations.

CAPABILITY UNIT IIIe–2

This unit consists of moderately well drained soils on old terraces. Slopes are 0 to 15 percent. Permeability is slow or very slow in the lower part of the subsoil. These soils hold 7 to 10 inches of water that plants can use. Surface runoff is very slow to medium, and the hazard of erosion is slight to moderate. In areas trampled by livestock or cultivated, a compacted layer, or pan, tends to form just below the surface when the soil is wet. The pan reduces the rate at which water and roots penetrate the soil.

The principal crops are hay and pasture plants, strawberries, cane fruit, and small grain. Suitable grasses are orchardgrass, tall fescue, ryegrass, and timothy. Suitable legumes are red clover, white clover, alsike clover, and birdsfoot trefoil.

The compacted layer can be corrected by varying the depth of tillage and by not pasturing or tilling the soil when wet. In some places it is necessary to install open or random tile lines to drain excess water from basins, potholes, or seep areas. Land smoothing and sloping improve surface drainage. Soils steeper than 3 percent should be tilled across the slope to help control erosion (fig. 18). A suitable level of organic matter can be maintained by applying barnyard manure, by growing green-manure crops, and by growing soil conserving crops, such as grasses and legumes, about half the time.

Nonlegumes respond to nitrogen fertilizer. Most crops respond to phosphorus. Legumes and high yielding crops under irrigation respond to applications of agricultural lime.

Sprinkler irrigation is beneficial but is not essential to the growth of crops. Frequent checks of soil moisture are helpful in determining the interval between irrigations.

CAPABILITY UNIT IIIe–3

This unit consists of well-drained soils on uplands. Slopes are 3 to 15 percent. Permeability is moderate. These soils hold about 5 to 10 inches of water that plants can use. Surface runoff is slow to medium, and the erosion hazard is slight to moderate.

These soils are used mainly for woodland, but they could be used more intensively, for example, for hay, pasture, and small grain.

A suitable level of organic matter can be maintained by applying barnyard manure and by growing close-growing crops, such as grasses and legumes, in rotation. In places cobblestones interfere with tillage. These soils should be tilled across the slope to help control erosion.

Figure 18.—**Erosion in Olequa silt loam, moderately well drained variant, 3 to 8 percent slopes. This field has been plowed up and down the slope. Capability unit IIIe–2.**

CAPABILITY UNIT IIIe–4

Coweeman silt loam, 5 to 15 percent slopes, a somewhat poorly drained soil on uplands, is the only soil in this unit. Permeability is very slow. The soil holds about 9 inches of water that plants can use. Surface runoff is medium, and the erosion hazard is slight to moderate. In areas trampled by livestock or cultivated, a compacted layer, or pan, tends to form just below the surface when the soil is wet. The pan reduces the rate at which roots and water penetrate the soil.

This soil is used principally for hay, pasture, and woodland. If it is drained, small grain, strawberries, and some truck crops can be grown. In drained areas, suitable grasses are orchardgrass, tall fescue, ryegrass, timothy, and meadow foxtail. Suitable legumes are white clover, red clover, alsike clover, and birdsfoot trefoil.

The compacted layer can be corrected by varying the depth of tillage, by deep plowing, and by not tilling or pasturing the soil when wet. Drainage can be improved by installing open drains and drain tile. In some places excess water can be drained from potholes, basins, and seep areas by installing random tile drain lines and by land smoothing and sloping. A suitable level of organic matter can be maintained by applying barnyard manure, by growing green-manure crops in the rotation and by growing soil conserving crops, such as grasses and legumes, about half the time. Tilling across the slope helps control erosion.

Crops respond to applications of commercial fertilizer. Nonlegumes respond to nitrogen fertilizer. Most crops respond to phosphorus. Legumes and high-yielding crops under irrigation respond to applications of agricultural lime.

Sprinkler irrigation is beneficial, but is not essential

to the growth of crops. Frequent checks of soil moisture are helpful in determining the interval between irrigations.

CAPABILITY UNIT IIIw-1

This unit consists of somewhat poorly drained soils on terraces. Slopes are 0 to 8 percent. Permeability is slow to very slow. These soils hold about 5 to 10 inches of water that plants can use. Surface runoff is very slow to slow, and the hazard of erosion is none to slight. In areas trampled by livestock or cultivated, a compacted layer, or pan, forms just below the surface. The pan reduces the rate at which water and roots penetrate the soil.

In undrained areas, these soils are suited only to wet-tolerant grasses, legumes, and trees. If drained, they are suited to strawberries, cane fruit, potatoes, cabbage, small grain, pasture, and hay. Suitable grasses in drained areas are orchardgrass, tall fescue, ryegrass, timothy, and meadow foxtail. Suitable legumes are white clover, red clover, alsike clover, and birdsfoot trefoil.

These soils can be drained by installing open or tile drains. In some places, tile drains and land smoothing and sloping are needed to drain water from basins, potholes, and seep areas. The compacted layer, or pan, can be corrected by varying the depth of tillage and by not pasturing or tilling the soils when wet. Good tilth and an adequate supply of organic matter can be maintained by applying barnyard manure and by growing soil conserving crops, such as grasses and legumes, about half the time. Soils steeper than 3 percent should be tilled across the slope to help control erosion.

Most crops respond to a complete fertilizer that contains nitrogen, phosphorus, and potassium. In some places, lime is also needed.

Sprinkler irrigation is beneficial but is not essential to the growth of crops. Frequent checks of soil moisture in the field are helpful in determining the interval between irrigations.

CAPABILITY UNIT IIIw-2

In this unit are moderately well drained to poorly drained soils. Slopes are 0 to 8 percent. Permeability is very slow. These soils hold about 7 to 8 inches of water that plants can use. Surface runoff is very slow to slow, and the hazard of erosion is slight, except in areas subject to flooding. In areas trampled by livestock or cultivated, a compacted layer, or pan, tends to form just below the surface. The pan reduces the rate at which water and roots can penetrate the soil.

In undrained areas these soils are suited only to wet-tolerant grasses, legumes, and trees. If drained, they are suited to small grain, hay, and pasture. Where the soils are drained, suitable grasses are orchardgrass, tall fescue, ryegrass, timothy, and meadow foxtail, and suitable legumes are white clover, red clover, alsike clover, and birdsfoot trefoil.

The pan can be corrected by varying the depth of tillage and by not pasturing or tilling the soil when wet. Open drains and random tile drains are generally adequate. In some places water can be drained from basins and potholes by installing tile drains and by land smoothing and sloping. Soils steeper than 3 percent should be tilled across the slope to help control erosion. A suitable level of organic matter can be maintained by applying barnyard manure, by returning crop residue to the soil, by using green-manure crops in the rotation, and by growing soil conserving crops, such as grasses and legumes, about half the time.

Crops respond to a complete commercial fertilizer that contains nitrogen, phosphorus, and potassium. In some places, lime is also needed.

Sprinkler irrigation during the growing season is beneficial but not essential to the growth of crops. Frequent checks of soil moisture in the field are helpful in determining the interval between irrigations.

CAPABILITY UNIT IIIw-3

Rose Valley silt loam, 0 to 8 percent slopes, a somewhat poorly drained soil on old terraces, is the only soil in this unit. Permeability is very slow. This soil holds about 7 to 9 inches of water that plants can use. Surface runoff is slow to medium and there is a slight to moderate hazard of erosion and soil slip. In areas trampled by livestock or cultivated, a compacted layer, or pan, tends to form just below the surface when this soil is wet. The pan reduces the rate at which roots and water penetrate the soil.

This soil is used principally for hay, pasture, and woodland, but if drained, it can also be used for small grain, strawberries, and truck crops. If it is drained, suitable grasses are orchardgrass, tall fescue, ryegrass, timothy, and meadow foxtail, and suitable legumes are white clover, red clover, alsike clover, and birdsfoot trefoil.

The compacted layer can be corrected by varying the depth of tillage, by deep plowing, and by not tilling or pasturing when the soil is wet. Drainage can be improved by installing open drains and drain tile. In some places, excess water can be drained from potholes, basins, and seep areas by installing random tile drains and by land smoothing and sloping. Soils steeper than 3 percent should be tilled across the slope to help control erosion. A suitable level of organic matter can be maintained by applying barnyard manure, by growing green-manure crops in the rotation, and by growing soil conserving crops, such as grasses and legumes, about half the time. To help prevent soil slip, care should be taken in making road cuts and in excavating.

Crops respond to applications of commercial fertilizer. Nonlegumes respond to nitrogen fertilizer. Most crops respond to applications of phosphorus. Legumes and high-yielding crops under irrigation respond to applications of agricultural lime.

Sprinkler irrigation, though beneficial, is not essential to the growth of crops. Frequent checks of soil moisture are helpful in determining the interval between irrigations.

CAPABILITY UNIT IVe-1

This unit consists of well drained and moderately well drained soils on uplands and terraces. Slopes are 8 to 30 percent. Permeability is very slow to moderate. These soils hold 7 to more than 10 inches of water that plants can use. Surface runoff is medium to rapid, and the erosion hazard is moderate to severe. Some of these soils are cobbly.

The soils are used principally for woodland. Some areas have been cleared for hay, pasture, and grain. Suitable grasses are orchardgrass, tall fescue, ryegrass, and

timothy. Suitable legumes are red clover, white clover, subclover, and birdsfoot trefoil and in some areas alfalfa.

Tilling across the slope helps control erosion. The supply of organic matter can be increased by applying barnyard manure, by growing green-manure crops in rotation and by growing soil conserving crops, such as grasses and legumes, about 2 years in 3.

Crops respond to applications of commercial fertilizer. Nonlegumes respond to nitrogen fertilizer. Most crops respond to applications of phosphorus. Legumes benefit from lime.

Sprinkler irrigation, though beneficial, is not essential to the growth of crops. Frequent checks of moisture in the field are helpful in determining the interval between irrigations.

CAPABILITY UNIT IVe–2

This unit consists of well-drained and somewhat excessively drained soils on uplands. Slopes are 8 to 30 percent. Permeability is moderate to rapid. These soils hold about 6 to 10 inches of water that plants can use. Surface runoff is slow to rapid, and the erosion hazard is moderate to severe.

These soils are used for woodland. They also can be used for hay, pasture, and small grain.

Tilling across the slope and growing grasses and legumes in a rotation most of the time help control erosion.

Nonlegumes respond to nitrogen. Most crops respond to phosphorus. Legumes respond to lime.

CAPABILITY UNIT IVe–3

In this unit are moderately well drained soils on terraces. Slopes are 8 to 30 percent. Permeability is slow. These soils hold more than 10 inches of water that plants can use. Surface runoff is medium to rapid, and the hazard of erosion and soil slip is moderate to severe. In areas trampled by livestock or cultivated, a compacted layer, or pan, tends to form just below the surface when the soils are wet. The pan reduces the rate at which roots and water penetrate the soil.

The principal crops are hay and pasture plants, but strawberries, cane fruit, and small grain and most truck crops can be grown. Suitable grasses on these soils are orchardgrass, tall fescue, ryegrass, and timothy. Suitable legumes are red clover, white clover, alsike clover, and birdsfoot trefoil.

The pan can be corrected by varying the depth of tillage and by not pasturing or tilling when the soil is wet. In some areas installing open drains or random drain-tile lines to drain excess water from potholes, basins, and seep areas should be considered. Tilling should be done across the slope to help control erosion. A suitable level of organic matter can be maintained by applying barnyard manure, by growing green-manure crops in rotation, and by growing soil conserving crops, such as grasses and legumes, about 2 years in 3. To help prevent soil slip, care should be taken in making road cuts and in excavating.

Nonlegumes respond to nitrogen fertilizer. Most crops respond to applications of phosphorus. Legumes and high-yielding crops in irrigated areas respond to applications of agricultural lime.

Sprinkler irrigation is beneficial but not essential to the growth of most crops. Frequent checks of soil moisture in the field are helpful in determining the frequency of irrigation.

CAPABILITY UNIT IVe–4

Only Minniece silt loam, 8 to 25 percent slopes, is in this unit. It is a somewhat poorly drained soil on terraces and uplands and in outwash areas. Permeability is very slow. The soil holds about 5 to 7 inches of water that plants can use. Surface runoff is medium to rapid, and the erosion hazard is moderate to severe. In areas trampled by livestock or cultivated, a compacted layer, or pan, tends to form just below the surface. The pan reduces the rate at which water and roots penetrate the soil.

The principal crops grown on this soil are hay and pasture plants and trees. If drainage is adequate, strawberries, cane fruit, small grain, and truck crops can be grown. Suitable grasses in drained areas are orchardgrass, tall fescue, ryegrass, timothy, and meadow foxtail, and suitable legumes are white clover, red clover, alsike clover, and birdsfoot trefoil.

The compacted layer can be corrected by varying the depth of tillage and by not tilling or pasturing when the soil is too wet. This soil can be drained by installing open drains and drain tile. In some places excess water can be drained from potholes, seep areas, and basins by installing random tile lines.

Tilling across the slope helps control erosion. A suitable level of organic matter can be maintained by applying barnyard manure, by growing green-manure crops in rotation, and by growing soil conserving crops about 2 years in 3.

Crops respond to applications of commercial fertilizer. Nonlegumes respond to nitrogen fertilizer. Most crops respond to applications of phosphorus. Legumes and high-yielding crops under irrigation respond to applications of agricultural lime.

Sprinklers are used for irrigating. Frequent checks of soil moisture in the field help in determining the interval between irrigations.

CAPABILITY UNIT IVe–5

Only Rose Valley silt loam, 8 to 15 percent slopes, is in this unit. This is a somewhat poorly drained soil on old terraces. It is very slowly permeable. It holds about 7 to 9 inches of water that plants can use. Surface runoff is medium to rapid, and the hazards of erosion and soil slip (fig. 19) are severe. In areas trampled by livestock or cultivated, a compacted layer, or pan, tends to form just below the surface when the soil is wet. The pan reduces the rate at which roots and water penetrate the soil.

This soil is used principally for hay, pasture, and wood crops. If drained, it can also be used for small grain, strawberries, and truck crops. In drained areas, suitable grasses are orchardgrass, tall fescue, ryegrass, timothy, and meadow foxtail, and suitable legumes are white clover, red clover, alsike clover, and birdsfoot trefoil.

The compacted layer can be corrected by varying the depth of tillage and by not tilling or pasturing when the soil is wet. Drainage can be improved by installing

Figure 19.—**Soil slip in a road cut in unstable Rose Valley silt loam, 8 to 15 percent slopes. Capability unit IVe–5.**

open and tile drains. In some places excess water can be drained from potholes, basins, and seep areas by installing random tile drains and by land smoothing and sloping. Tilling across the slope helps control erosion. A suitable level of organic matter can be maintained by applying barnyard manure, by growing green-manure crops in rotation, and by growing soil conserving crops, such as grasses and legumes, about 2 years in 3. To help prevent soil slip, care should be taken in making road cuts and in excavating.

Crops respond to applications of commercial fertilizer. Nonlegumes respond to nitrogen fertilizer. Most crops respond to applications of phosphorus. Legumes and high-yielding crops under irrigation respond to applications of agricultural lime.

Sprinkler irrigation is beneficial but not essential to the growth of crops. To determine the interval between irrigations, frequent checks of soil moisture are helpful.

CAPABILITY UNIT IVe–6

Only Coweeman silty clay loam, 8 to 30 percent slopes, is in this unit. This somewhat poorly drained soil is on uplands. It holds about 5 to 7 inches of water that plants can use. Permeability is very slow. Surface runoff is medium to rapid, and the erosion hazard is moderate to severe.

This soil is used mainly for timber. Hay and pasture plants and small grain are grown in a few places.

Tilling across the slope and keeping the soil in grasses and legumes most of the time help control erosion.

Most crops respond to phosphorus. Nonlegumes respond to nitrogen, and legumes respond to lime.

CAPABILITY IVe–7

This unit consists of well-drained soils on uplands and terraces. Slopes are 0 to 30 percent. Permeability is moderate. These soils hold from 8 to 10 inches of water

that plants can use. Surface runoff is slow to rapid, and the erosion hazard is slight to severe.

The principal farm crops grown on these soils are hay and pasture plants and small grain. Suitable grasses are orchardgrass, tall fescue, ryegrass, and timothy. Suitable legumes are white clover, red clover, birdsfoot trefoil, and subclover. These soils are much less productive than the same soils in adjacent Clark County, and they are suited to a narrower range of crops.

Soils steeper than 3 percent should be tilled across the slope to help control erosion. A suitable level of organic matter can be maintained by applying manure, by growing green-manure crops in rotation, and by growing soil conserving crops, such as grasses and legumes, about 2 years in 3.

Crops respond to applications of commercial fertilizer. Nonlegumes respond to nitrogen fertilizer. Most crops respond to phosphorus. Applications of lime are beneficial when followed by commercial fertilizers, especially where sprinkler irrigation is used.

Sprinklers are used for irrigating. Frequent checks of soil moisture in the fields are helpful in determining the interval between irrigations.

CAPABILITY UNIT IVe-8

Only Sifton gravelly loam, 0 to 8 percent slopes, is in this unit. This is a somewhat excessively drained soil on long narrow flood plains and terraces. It holds about 2 to 4 inches of water that plants can use. Permeability is very rapid. Surface runoff is slow. On the flood plains, the erosion hazard from flooding is slight to moderate.

This soil is used for timber, pasture, and hay. Suitable grasses are orchardgrass, tall fescue, and ryegrass. Suitable legumes are white clover, red clover, and birdsfoot trefoil.

A suitable level of organic matter can be maintained by applying barnyard manure and by growing soil conserving crops, such as grasses and legumes, about 2 years in 3.

Crops respond to applications of commercial fertilizer. Nonlegumes respond to nitrogen fertilizer. Most crops respond to applications of phosphorus.

Sprinklers are used for irrigating. Frequent checks of soil moisture are helpful in determining the interval between irrigations.

CAPABILITY UNIT IVe-9

Only Cispus gravelly sandy loam, 8 to 20 percent slopes, is in this unit. This somewhat excessively drained soil is on uplands. It holds about 4 inches of water that plants can use. Permeability is very rapid. Surface runoff is slow, and the erosion hazard is moderate.

This soil is used for timber. It can be used for hay, pasture, and small grain.

Tilling across the slope and growing grasses and legumes most of the time help control erosion.

Most crops respond to phosphorus. Nonlegumes respond to nitrogen.

CAPABILITY UNIT IVw-1

Rose Valley silt loam, thin surface variant, 0 to 6 percent slopes, is the only soil in this unit. This poorly drained soil is on terrace slopes. It holds about 4 to 6 inches of water that plants can use. Permeability is very slow. Surface runoff is very slow to slow, and the erosion hazard is none to slight. In areas trampled by livestock or cultivated, a compacted layer, or pan, tends to form just below the surface when the soil is wet. The pan reduces the rate at which roots and water penetrate the soil.

In undrained areas only wet-tolerant grasses and legumes, such as reed canarygrass and big trefoil, and trees can be grown. Drained areas can be used for improved pasture plants, hay, and small grain. Suitable grasses in drained areas are timothy, meadow foxtail, and tall fescue, and suitable legumes are big trefoil, white clover, and alsike clover. The compacted layer can be corrected by varying the depth of tillage and by not tilling or pasturing the soil when wet.

This soil can be drained by installing open drains or tile drains. In some places tile drains and land smoothing and sloping are needed to drain excess water from potholes, basins, and seep areas. A suitable level of organic matter can be maintained by applying barnyard manure, by growing green-manure crops in rotation, and by growing soil conserving crops 2 years in 3.

Crops respond to applications of commercial fertilizer. Nonlegumes respond to nitrogen fertilizer. Most crops respond to phosphorus. Applications of lime have proven beneficial when followed by commercial fertilizer, especially if sprinkler irrigation is used.

Sprinklers are used for irrigating. Frequent checks of soil moisture in the fields are helpful in determining the interval between irrigations.

CAPABILITY UNIT IVw-2

Only Coweeman silty clay loam, dark variant, 0 to 4 percent slopes, is in this unit. This poorly drained soil is on uplands. It holds about 7 to 8 inches of water that plants can use. Permeability is very slow. Surface runoff is very slow, and the erosion hazard is none to slight.

In drained areas this soil is used for hay and pasture plants and small grain. Suitable grasses in drained areas are orchardgrass, tall fescue, ryegrass, timothy, and meadow foxtail, and suitable legumes are white clover, red clover, alsike clover, and birdsfoot trefoil.

Crops respond to applications of commercial fertilizer containing nitrogen, phosphorus, and potassium.

In most places this soil can be drained by installing open drains or tile drains. In some places tile drains and land smoothing and sloping are needed to drain excess water from basins, potholes, and seep areas.

CAPABILITY UNIT VIe-1

This unit consists of moderately well drained to somewhat excessively drained soils on uplands and terrace fronts. Slopes are 15 to 50 percent. Permeability is very slow to rapid. The soil holds about 6 inches to more than 10 inches of water that plants can use. Surface runoff is medium to very rapid, and the erosion hazard is moderate to very severe.

These soils are used for woodland.

CAPABILITY UNIT VIe-2

Only Rose Valley silt loam, 15 to 30 percent slopes, is in this unit. This soil is somewhat poorly drained

and has very slow permeability. It holds about 7 to 9 inches of water that plants can use. Surface runoff is rapid. The hazards of erosion and soil slip are very severe.

This soil is used for woodland.

CAPABILITY UNIT VIe-3

This unit consists of somewhat excessively drained and excessively drained soils on terraces and uplands. Slopes are 15 to 60 percent. Permeability is very rapid. The soils hold about 4 inches of water that plants can use. Surface runoff is slow to medium, and the hazard of erosion is moderate to severe.

These soils are used for woodland.

CAPABILITY UNIT VIs-1

This unit consists of excessively drained and somewhat excessively drained soils on terraces and uplands. Slopes are 8 to 60 percent. Permeability is slow to very rapid. These soils hold 1 to 4 inches of water that plants can use. Surface runoff is slow to rapid, and the erosion hazard is moderate to very severe.

These soils are used for woodland.

CAPABILITY UNIT VIs-2

This unit consists of excessively drained soils on bottom land and terraces. Slopes are 0 to 8 percent. Permeability is very rapid. These soils hold 3 to 4 inches of water that plants can use. Surface runoff is slow to very slow. Unless these soils are protected by dikes, the erosion hazard from flooding is moderate to severe in a few places on some of these soils.

These soils are used for hay, pasture, and woodland. Suitable grasses are orchardgrass, tall fescue, and ryegrass. Suitable legumes are red clover, white clover, and subclover.

CAPABILITY UNIT VIs-3

Only Olympic cobbly silt loam, 0 to 20 percent slopes, is in this unit. This soil is well drained and has moderately slow permeability. It holds about 4 to 6 inches of water that plants can use. Surface runoff is slow to medium, and the erosion hazard is slight to moderate.

This soil is used for woodland.

CAPABILITY UNIT VIs-4

The one soil in this unit, Speelyai gravelly loamy sand, 0 to 8 percent slopes, is a somewhat excessively drained, slowly permeable soil. It holds about 1 inch of water that plants can use. Surface runoff is very slow, and the erosion hazard is none to slight.

This soil is used principally for woodland, but some areas are cleared and used for hay and pasture.

Suitable grasses are orchardgrass, tall fescue, and ryegrass. Suitable legumes are red clover, white clover, and subclover.

TABLE 2.—*Estimated average yields per acre of*

[Yields in columns A are those to be expected under common management; those in colums B, under

Soil	Orchardgrass-New Zealand white clover		Alta fescue-New Zealand white clover		Alta fescue-subclover	
	A	B	A	B	A	B
	A.U.M.[1]	*A.U.M.*[1]	*A.U.M.*[1]	*A.U.M.*[1]	*A.U.M.*[1]	*A.U.M.*[1]
Camas cobbly loam	1. 5	3. 0	1. 5	3. 0	1. 5	3. 0
Caples silt loam	[2] 6. 0	[3] 12. 0	6. 0	12. 0	----------	----------
Caples silty clay loam	[2] 6. 0	[3] 12. 0	6. 0	12. 0	----------	----------
Cinebar gravelly silt loam, 0 to 8 percent slopes	2. 5	4. 0	2. 5	4. 0	2. 0	3. 5
Cinebar gravelly silt loam, 8 to 20 percent slopes	2. 0	3. 5	2. 0	3. 5	2. 0	3. 0
Cinebar gravelly silt loam, 20 to 30 percent slopes	1. 5	3. 0	1. 5	2. 5	1. 5	2. 5
Cinebar loam, 0 to 8 percent slopes	2. 5	4. 0	2. 5	4. 0	2. 0	3. 5
Cinebar silt loam, 8 to 20 percent slopes	2. 0	3. 5	2. 0	3. 5	2. 0	3. 0
Cinebar silt loam, 20 to 30 percent slopes	1. 5	3. 0	1. 5	3. 0	1. 5	2. 5
Clato silt loam	[2] 7. 5	[3] 12. 0	7. 5	12. 0	----------	----------
Clato silt loam, coarse variant	4. 5	10. 5	4. 5	10. 5	----------	----------
Coweeman silt loam, 5 to 15 percent slopes	3. 5	8. 0	3. 5	8. 0	----------	----------
Coweeman silty clay loam, 8 to 30 percent slopes	3. 5	7. 5	3. 5	8. 0	----------	----------
Coweeman silty clay loam, dark variant, 0 to 4 percent slopes	3. 5	7. 5	3. 5	8. 0	----------	----------
Gee silt loam, 0 to 8 percent slopes	4. 5	9. 0	4. 5	9. 0	----------	----------
Gee silt loam, 8 to 15 percent slopes	4. 0	8. 5	4. 0	8. 5	----------	----------
Germany silt loam, 0 to 8 percent slopes	4. 0	8. 5	4. 0	8. 5	3. 5	8. 0
Germany silt loam, 8 to 20 percent slopes	3. 5	8. 0	3. 5	8. 0	3. 0	7. 5
Germany silt loam, 20 to 30 percent slopes	3. 0	7. 0	3. 0	7. 0	2. 5	6. 5
Godfrey silt loam	[2] 5. 0	[3] 10. 0	5. 0	10. 0	----------	----------
Godfrey silty clay loam	[2] 5. 0	[3] 10. 0	5. 0	10. 0	----------	----------
Hillsboro silt loam, 0 to 40 percent slopes, 0 to 8 percent part only	[2] 5. 5	[3] 11. 0	5. 5	11. 0	----------	----------
Hillsboro silt loam, 0 to 40 percent slopes, 8 to 30 percent part only	4. 5	9. 5	4. 5	9. 5	----------	----------
Kalama gravelly loam, 0 to 8 percent slopes	4. 0	8. 5	4. 0	8. 5	3. 5	8. 0
Kalama gravelly loam, 8 to 15 percent slopes	3. 5	8. 0	3. 5	8. 0	3. 0	7. 5
Kalama gravelly loam, 15 to 30 percent slopes	3. 0	7. 0	3. 0	7. 0	2. 5	6. 5

See footnotes at end of table.

The supply of organic matter can be maintained by applying barnyard manure and by growing soil conserving crops, such as grasses and legumes, all the time.

CAPABILITY UNIT VIIs-1

This unit consists of Rock land. Slopes range from 3 to more than 45 percent.

Brush and trees are the principal kinds of vegetation. Rock land is suitable for woodland and for use as recreational areas and wildlife habitat.

CAPABILITY UNIT VIIIw-1

Riverwash is in this capability unit. It occurs as stream deposits of poorly sorted sands, gravel, and cobblestones. It is frequently overflowed and altered by erosion and deposition. Much of it supports no vegetation, but there are scattered, thin stands of willow, cottonwood, red alder, and brush.

Riverwash is not suited to farm crops. It is used for wildlife habitat and recreation. Some areas provide a source of gravel.

CAPABILITY UNIT VIIIw-2

The one soil in this unit, Semiahmoo peat, is a very poorly drained, organic soil in low depressions in marshes or swamps, and in areas bordering lakes and ponds. Under natural conditions it is ponded the year around. There is no erosion hazard.

This soil is used for wildlife. Drainage is not feasible on most of the acreage.

CAPABILITY UNIT VIIIs-1

Made land makes up this unit. It is dike land consisting mostly of sand pumped in from dredging operations. It protects bottom lands from seasonal flooding. It has no value for farming. The most suitable use is wildlife habitat.

Estimated Yields

Estimated average yields per acre of the principal crops grown on the arable soils in the Cowlitz Area are given in table 2. In columns A are listed yields to be expected under the management practices followed by most of the farmers in the Area. In columns B are yields to be expected under improved management.

The figures in columns A are based largely on observations and data collected by members of the soil survey party and other Soil Conservation Service personnel, and on information obtained by interviews with farmers and other agricultural workers experienced with the soils and crops of the Area. Comparisons were made with yield tables for other counties in Washington that have similar soils.

principal crops under two levels of management

improved management. Absence of yield figure indicates crop is not commonly grown on the particular soil]

Meadow foxtail-big trefoil		Alfalfa-orchardgrass hay		Oats (hay)		Corn (silage)		Strawberries	
A	B	A	B	A	B	A	B	A	B
A.U.M.[1]	*A.U.M.*[1]	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*
6.0	12.0			1.5	2.5	[4] 15	[3] 20	[5] 3.0	[5] 4.5
6.0	12.0			1.5	2.5	[4] 15	[3] 20		
				1.0	1.5				
				1.0	1.5				
				1.0	1.5				
				1.0	1.5				
		[3] 3.0	[3] 5.0	1.5	2.5	[4] 15	[3] 20	[5] 3.5	[5] 5.5
				1.5	2.0	10	15	4.0	5.5
3.5	8.0			1.0	1.5				
3.5	8.0			1.0	1.5				
3.5	8.0			1.0	1.5				
				1.0	2.0			2.5	4.0
				1.0	2.0			2.5	3.5
				1.0	1.5			3.5	5.0
				1.0	1.5			3.0	4.5
				.5	1.0				
5.0	10.0			1.5	2.0	[4] 12	[3] 17		
5.0	10.0			1.5	2.0	[4] 12	[3] 17		
		[3] 3.0	[3] 4.5	1.5	2.0	[4] 12	[3] 16	[5] 3.5	[5] 5.5
		2.5	4.0	1.0	1.5	10	15	4.0	5.5
				1.5	2.0			2.5	4.0
				1.5	2.0			2.5	3.5
				1.0	1.5				

TABLE 2.—*Estimated average yields per acre of*

Soil	Orchardgrass-New Zealand white clover		Alta fescue-New Zealand white clover		Alta fescue-subclover	
	A	B	A	B	A	B
	A.U.M.[1]	*A.U.M.*[1]	*A.U.M.*[1]	*A.U.M.*[1]	*A.U.M.*[1]	*A.U.M.*[1]
Kelso silt loam, 0 to 8 percent slopes	[2] 4.5	[3] 9.0	4.5	9.0		
Kelso silt loam, 8 to 15 percent slopes	[2] 4.5	[3] 9.0	4.5	9.0		
Kelso silt loam, 15 to 30 percent slopes	3.5	7.0	3.5	7.0		
Mart silt loam, 0 to 8 percent slopes	4.5	8.5	4.5	8.5	4.0	8.0
Mart silt loam, 8 to 20 percent slopes	4.0	8.0	4.0	8.0	3.5	7.5
Mart silt loam, 20 to 30 percent slopes	3.0	6.0	3.0	6.0	2.5	5.5
McBee silty clay	4.5	9.0	6.0	10.5		
Minniece silt loam, 0 to 8 percent slopes	4.0	8.5	4.0	8.5		
Minniece silt loam, 8 to 25 percent slopes	3.5	8.0	3.5	8.0		
Minniece silt loam, loamy variant, 0 to 3 percent slopes	3.0	6.0	3.0	6.0		
Newberg fine sandy loam	[2] 7.0	[3] 11.0	7.0	11.0	6.0	10.0
Newberg silt loam, silty variant	[2] 6.0	[3] 12.0	6.0	12.0		
Olequa silt loam, 0 to 8 percent slopes	4.0	9.0	4.0	9.0	3.5	8.0
Olequa silt loam, 8 to 20 percent slopes	3.5	8.5	3.5	8.5	3.5	7.5
Olequa silt loam, 20 to 30 percent slopes	3.0	7.0	3.0	7.0	3.0	6.5
Olequa silt loam, moderately well drained variant, 3 to 8 percent slopes	4.5	10.0	4.5	10.0		
Olequa silt loam, moderately well drained variant, 8 to 15 percent slopes	4.0	9.0	4.0	9.0		
Olympic gravelly silt loam, 2 to 8 percent slopes	4.0	8.5	4.0	8.5	3.5	7.5
Olympic gravelly silt loam, 8 to 20 percent slopes	3.5	8.0	3.5	8.0	3.0	7.0
Olympic gravelly silt loam, 20 to 30 percent slopes	3.0	6.0	3.0	6.0	2.5	6.0
Olympic silt loam, 2 to 8 percent slopes	4.5	9.0	4.5	9.0	4.0	8.0
Olympic silt loam, 8 to 20 percent slopes	4.0	8.5	4.0	8.5	3.5	7.5
Olympic silt loam, 20 to 30 percent slopes	3.0	6.0	3.0	6.0	3.0	6.0
Pilchuck loamy fine sand, 0 to 8 percent slopes	1.0	2.5	1.0	2.5	1.0	2.0
Rose Valley silt loam, 0 to 8 percent slopes			4.5	9.0		
Rose Valley silt loam, 8 to 15 percent slopes			4.5	9.0		
Rose Valley silt loam, thin surface variant, 0 to 6 percent slopes	3.0	6.0	3.0	6.0		
Sara silt loam, 0 to 8 percent slopes	4.5	9.5	4.5	9.5		
Sara silt loam, 8 to 15 percent slopes	4.5	9.5	4.5	9.5		
Sara silt loam, 15 to 30 percent slopes	3.5	7.0	3.5	7.0		
Sara silty clay loam, 0 to 8 percent slopes	4.5	9.5	4.5	9.5		
Sauvola loam, 0 to 8 percent slopes	4.5	9.0	4.5	9.0	4.0	8.5
Sauvola loam, 8 to 15 percent slopes	4.5	8.5	4.5	8.5	3.5	8.0
Sauvola loam, 15 to 30 percent slopes	3.5	7.0	3.5	7.0	2.5	6.5
Seaquest silt loam, 0 to 8 percent slopes	4.5	8.5	4.5	8.5	4.0	8.0
Seaquest silt loam, 8 to 20 percent slopes	4.0	8.5	4.0	8.5	3.5	7.5
Seaquest silt loam, 20 to 30 percent slopes	3.5	7.0	3.5	7.0	2.5	6.0
Semiahmoo peat			2.0	3.5		
Sifton gravelly loam, 0 to 8 percent slopes	3.0	5.0	3.0	5.0	2.5	4.5
Snohomish silty clay loam	[2] 6.0	[3] 12.0	6.0	12.0		
Toutle fine sandy loam, 0 to 8 percent slopes	1.5	3.0	1.5	3.0	1.5	3.0
Toutle loamy sand, 0 to 8 percent slopes	1.0	2.5	1.0	2.5	1.0	2.5

[1] Animal-unit-months. This is a term used to express the number of months that one mature animal (cow, horse, or mule) can graze 1 acre without injury to the pasture.

[2] Irrigation increases yields approximately 100 percent.

The yields in columns B are based largely on data and estimates made by men who have had experience with the crops and soils of the county, yield data obtained from farmers who have used the best current management practices, data from outlying testing plots sponsored by the Cowlitz County Agricultural Extension Service, and data from field-sized plantings on SWCD cooperator's farms. The known deficiencies of the soils were considered in judging how much yields might increase if these deficiencies were corrected within practical limits. These limits cannot be precisely defined, nor can response to good management be precisely predicted. A comparison of yields in columns B with those in columns A, however, indicates that on nearly all soils of the survey area, more intensive management significantly increases yields.

Current practices under B level management for four important crops follow.

Alfalfa-orchardgrass for hay: (1) Use of recommended varieties; (2) inoculation of legume seed; (3) preparation of a clean, firm seedbed; (4) fertilization in amounts determined by soil tests, or about 30 pounds of nitrogen, 35 pounds of phosphorus, and 4 pounds of boron per acre at time of seeding and 25 to 35 pounds of phosphorus in alternate years; and (5) maintenance of base saturation value of at least 60 percent.

principal crops under two levels of management—Continued

Meadow foxtail-big trefoil		Alfalfa-orchardgrass hay		Oats (hay)		Corn (silage)		Strawberries	
A	B	A	B	A	B	A	B	A	B
A.U.M.[1]	*A.U.M.*[1]	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*
				1.5	2.0	[4] 10	[3] 15	[5] 3.5	[5] 5.5
				1.5	2.0	[4] 10	[3] 15	[5] 3.5	[5] 5.0
				1.0	1.5				
				1.0	1.5			3.0	5.5
				1.0	1.5			3.0	5.0
				.5	1.0				
				1.5	2.5	10	15		
4.0	8.5			1.0	1.5				
3.5	8.0			1.0	1.5				
3.0	6.0			1.0	1.5				
		[3] 3.0	[3] 5.0	1.5	2.5	[4] 12	[3] 18	[5] 3.0	[5] 5.5
				1.5	2.5	[4] 15	[3] 20	[5] 3.0	[5] 4.5
				1.0	1.5			3.0	4.5
				1.0	1.5			2.5	4.0
				.5	1.0				
				1.0	2.0			3.0	5.5
				1.0	2.0			3.0	5.0
				1.0	1.5			3.5	5.5
				1.0	1.5			3.0	5.0
				.5	1.0				
				1.0	1.5			3.5	5.5
				1.0	1.5			3.0	5.0
				.5	1.0				
4.5	9.0			1.0	1.5				
4.5	9.0			1.0	1.5				
3.0	6.0								
				1.5	2.0			3.0	4.5
				1.5	2.0			3.0	4.5
				1.5	2.0				
				1.0	1.5			3.0	4.5
				1.0	1.5			3.0	4.5
				.5	1.0				
				1.0	1.5			3.5	5.0
				1.0	1.5			3.0	4.5
				.5	1.0				
2.5	4.0								
				1.0	1.5				
6.0	12.0			1.5	2.5	[4] 15	[3] 20		

[3] Irrigation increases yields approximately 50 percent.
[4] Irrigation increases yields approximately 33 percent.
[5] Irrigation increases yields approximately 25 percent.

White clover-orchardgrass for pasture: (1) Use of recommended varieties; (2) inoculation of legume seed; (3) preparation of a clean, firm seedbed; (4) fertilization in amounts determined by soil tests, or about 30 pounds of nitrogen and 35 pounds of phosphorus per acre at time of seeding and either 30 to 50 pounds of nitrogen and 20 to 25 pounds of phosphorus or 20 to 35 pounds of nitrogen and 45 to 70 pounds of phosphorus early in spring; 50 to 65 pounds of nitrogen in midsummer, if the soil is irrigated; (5) maintenance of a pH value above 6.0; and (6) use of proper pasture management and irrigation practices.

Strawberries: (1) Use of recommended varieties; (2) maintenance of a plant population of 8,000 plants per acre in 40-inch rows with plants 18 inches apart; (3) fertilization in amounts determined by soil tests, or about 90 pounds of nitrogen, 60 pounds of phosphorus, and 80 pounds of potassium per acre; (4) use of irrigation if available; and (5) rotation with grasses and legumes as part of a soil conservation cropping system.

Corn silage: (1) Use of quality seed of recommended varieties; (2) maintenance of a plant population of 20,000 to 25,000 plants per acre; (3) fertilization in amounts determined by soil

test, or about 120 pounds of nitrogen, 35 pounds of phosphorus, and 80 pounds of potassium per acre; (4) use of irrigation where possible; and (5) rotation with grasses and legumes as part of a soil conservation cropping system. If the crop is irrigated, fertilization requirements are greater and plant population can be higher.

Woodland [2]

About 85 percent of the Cowlitz Area is classified as woodland. About 86 percent of the woodland is privately owned, 11 percent is State owned, and 3 percent is owned by the Federal Government.

Within the Area are some of the most productive soils in the State of Washington for growing Douglas-fir and red alder timber. Most of the forests have been logged one or more times. Several private timber companies have large holdings within the Area. Some are actively engaged in second growth timber management. Others are planning management programs.

On most of the small, privately owned tracts, there is little intensive management for wood products alone. Other uses for the woodland are competing for the time and money required for such management. The primary interest of the small woodland owner is often in recreation, esthetics, wildlife, or woodland investment. Intensive management of these woodland tracts can be expected to increase only when timber values increase or when management for wood products can be shown to improve the other values of the woodland.

[2] ALDEN N. QUAM and DAVID L. HINTZ, woodland specialists, Soil Conservation Service, assisted in writing this section.

Woodland groups and production of wood crops

The soils of the Cowlitz Area are grouped according to their suitability for wood crops. There are 17 groups. Each group consists of soils that are about the same in productivity of trees, and each group has soil-related limitations that require about the same woodland management.

Table 3 gives, in summary form, the estimates of productivity and the relative severity of the soil-related limitations for each of the 17 woodland groups of soils. The reader should refer to the "Guide to Mapping Units" for the woodland group designation of a particular soil.

Each woodland group in table 3 is identified by a symbol, for example, 2o1. The first element of the symbol is a number that indicates potential productivity by site class. The site class is based on the site index (*5*).

The numeral 1, denoting site class I, indicates a site index of 185 or more.

TABLE 3.—*Woodland groups, wood*

Woodland groups and map symbols	Important wood crops	Average or range of site index for Douglas-fir	Degree of hazards or limitations	
			Seedling mortality	Erosion hazard
1o1: GmB, GmC, GmD, GnD	Douglas-fir, western hemlock, western redcedar, red alder.	[1] 191	Slight	Slight to severe
1r1: GmE, GnE	Douglas-fir, western hemlock, western redcedar, red alder.	[1] 191	Slight	Severe
2o1: CoC[1], KeB, KeC, KeD[2]	Douglas-fir, red alder, western redcedar, bigleaf maple.	179	Slight	Slight to severe
2o2: CmB, CnC, CnD, CoB, CoD, OeB, OeC, OeD.	Douglas-fir, red alder, western redcedar, bigleaf maple, grand fir, cascara.	[3] 179	Slight	Slight to severe
2o3: MrB, MrC, MrD, OmB, OmC, OmD, SmB, SmC, SmD, VaD.	Douglas-fir, red alder, bigleaf maple, western redcedar, cherry, cascara, western hemlock.	160	Slight	Slight to severe
2r1: CoE[1], KeE[2], MrE, OeE, OmE, VaE.	Douglas-fir, red alder, western redcedar, bigleaf maple, grand fir, cascara.	160–179	Slight	Severe to very severe.
3d1: KaB, KaC, KaD, KaE, RvB, RvC, RvD.	Douglas-fir, red alder, western hemlock, western redcedar, bigleaf maple, willow.	150	Slight to moderate.	Slight to very severe.
3d2: CwC, CxD, Go, Gr, Mb, MtB, MtC, MvA, SaB, SaC, SaD, ScB.	Douglas-fir, western redcedar, red alder, grand fir, western hemlock, cascara, cherry, Oregon ash, willow, bigleaf maple.	130–149	Slight to moderate.	None to severe
3d3: Cv, GeB, GeC, GeD, OlB, OlC, SlB, SlC, SlD.	Douglas-fir, western hemlock, western redcedar, red alder, bigleaf maple, willow, cascara.	154	Slight to moderate.	Slight to severe

See footnotes at end of table.

The numeral 2, denoting site class II, indicates a site-index range of 155 to 184.

The numeral 3, denoting site class III, indicates a site-index range of 125 to 154.

The numeral 4, denoting site class IV, indicates a site-index range of 95 to 124.

The numeral 5, denoting site class V, indicates a site index of 65 to 94.

The second element of the symbol is a letter that denotes the subclass or the kind of soil limitation to be expected in woodland use and management.

The letter *d* denotes restricted rooting depth.
The letter *f*, gravel.
The letter *r*, slope.
The letter *s*, sand.
The letter *w*, wetness.
The letter *x*, stones or rocks.
The letter *o* denotes no limitation.

The third element of the symbol is a numeral that denotes a woodland suitability group made up of kinds of soil that produce similar kinds of wood crops, have similar management limitations, and have about the same productive potential.

Explanations of the ratings in table 3 follow:

Potential productivity is an indication of the amount of a given wood crop that a given soil can produce under a specified level of management. It is expressed as the site index, which is the average height, in feet, that the dominant trees of a given species, growing on a specified soil, will reach in a specified number of years. To obtain the average site index for a tree species on a specified soil, the average total ages and heights of dominant and codominant trees are determined on a number of soil plots. Site index based on this height-age relationship is then determined from formulas or tables developed for this purpose (*5*). The site index averages shown in table 3 are based on the average height of Douglas-fir and codominant trees at 100 years of age. Growth and yield figures for fully stocked, unmanaged stands of Douglas-fir are shown in table 4.

Seedling mortality refers to the expected loss of seedlings as a result of unfavorable soil characteristics or topographic features. Even though healthy seedlings of suitable species are correctly planted or occur naturally in adequate numbers, some will not survive if conditions are unfavorable. The degrees of seedling mortality shown in table 3 are based on mortality of seedlings among the number normally planted for adequate stocking. *Slight* indicates a loss of less than 25 percent of the seedlings; *moderate*, between 25 to 50 percent; and *severe*, more than 50 percent.

crops, and factors in management

Degree of hazards or limitations—Continued			Common understory plants
Windthrow hazard	Plant competition	Equipment limitations	
Slight	Moderate	Slight	Swordfern, bracken, vine maple, oxalis, devils club, elderberry, red huckleberry, huckleberry.
Slight	Moderate	Severe	Swordfern, bracken, vine maple, oxalis, devils club, elderberry, red huckleberry.
Slight	Moderate to severe	Moderate	Bracken, swordfern, salal, elderberry, red huckleberry, hazel.
Slight	Moderate	Slight	Vine maple, bracken, elderberry.
Slight	Moderate	Slight	Swordfern, vine maple, salmonberry, elderberry, red huckleberry, hazel.
Slight	Moderate to severe	Severe	Bracken, swordfern, salal, elderberry, red huckleberry, hazel, vine maple.
Slight to moderate	Moderate to severe	Slight to moderate. Severe on Rose Valley soils.	Cascara, salal, swordfern, bracken, Oregon-grape.
Moderate to severe	Moderate to severe	Severe	Sedges, salal, hazel, vine maple, evergreen blackberry, bracken, rose, swordfern, elderberry, Oregon-grape.
Moderate	Moderate	Slight to moderate	Swordfern, salal, Oregon-grape, hazel, vine maple, red and blue huckleberry, ocean-spray.

TABLE 3.—*Woodland groups, wood*

Woodland groups and map symbols	Important wood crops	Average or range of site index for Douglas-fir	Degree of hazards or limitations	
			Seedling mortality	Erosion hazard
3d4: BpD2, LbC, LbD, LbD2, LbE	Douglas-fir, red alder, grand fir	[1] 135	Moderate	Slight to very severe.
3f1: Ca, OyC, SrB	Douglas-fir, red alder, cascara, bigleaf maple.	140	Severe on Camas soils, slight to moderate on the rest.	Slight to moderate
3o1: BpC, BpD, HlD, OpB, OpC, OpD	Douglas-fir, red alder, western redcedar, western hemlock, bigleaf maple, cascara, dogwood.	[1] 141–154	Slight to moderate.	Slight to severe
3r1: BpE, HlD, OpE	Douglas-fir, red alder	[1] 141–154	Slight to moderate.	Severe
3s1: CsC, CsE, ToB, ToD, TtB, TuB, TuD.	Douglas-fir, lodgepole pine, red alder, black cottonwood, bigleaf maple, western hemlock, western redcedar.	130–151	Severe	Slight to severe
3x1: Ro	Douglas-fir, red alder, Oregon ash, bigleaf maple, willow.	130	Moderate to severe.	Slight to severe
4d1: CyB, RyB	Douglas-fir, red alder, Oregon ash, grand fir, western redcedar, western hemlock, cascara, cherry, willow.	120	Moderate	None to slight
5d1: SyB, SyE	Douglas-fir, red alder, bigleaf maple, western redcedar.	90	Moderate	Slight to very severe.

[1] Site index gradually decreases with increasing elevation above 500 feet. At 1,400 feet the site index is 150.
[2] Kelso soils are subject to slippage if slope is more than 8 percent. Road cuts slough, and erosion is severe.

crops, and factors in management—Continued

Degree of hazards or limitations—Continued			Common understory plants
Windthrow hazard	Plant competition	Equipment limitations	
Moderate	Moderate	Moderate	Huckleberry, salal, hazel, bracken.
Slight	Slight to moderate	Slight	Bracken, salal.
Slight	Moderate	Slight to moderate	Swordfern, bracken, vine maple, elderberry, salal, hazel, red huckleberry.
Slight	Moderate	Severe	Swordfern, bracken, vine maple.
Slight	Moderate	Slight to severe	Ocean-spray, salal, Oregon-grape, vine maple, evergreen blackberry, wild sweet blackberry.
Slight to moderate	Moderate	Moderate to severe	Bracken, salal, vine maple, evergreen blackberry.
Severe	Severe	Severe	Sedges, salal, vine maple, hazel, wild rose, bracken, swordfern, Oregon-grape, elderberry, evergreen blackberry.
Severe	Moderate	Slight	Bracken, Oregon-grape, salal, wild sweet blackberry.

[3] Site index gradually decreases with increasing elevation above 1,500 feet. At 2,600 feet the site index is about 105.
[4] Under 1,500 feet elevation, site index can be as high as 165, and at an elevation of 2,600 feet it can be as low as 118.

TABLE 4.—*Growth and yield for fully stocked, unmanaged stands of Douglas-fir*

Site index	Age in years	Total merchantable volume per acre			Average diameter in inches	Total number of trees per acre	Total square feet of basal area per acre
		Cubic feet [1]	Board feet [2] (International rule)	Board feet [3] (Scribner rule)			
100	20	100			1. 8	4, 150	76
	30	800			3. 4	1, 800	114
	40	1, 800			4. 9	1, 090	143
	50	3, 000	1, 900	1, 600	6. 3	764	165
	60	4, 300	5, 700	4, 800	7. 6	580	182
	70	5, 300	10, 600	9, 000	8. 8	468	197
	80	6, 200	16, 300	13, 900	9. 9	394	210
110	20	200			2. 2	3, 069	81
	30	1, 050			3. 9	1, 472	122
	40	2, 350	200	200	5. 5	927	153
	50	3, 800	3, 900	3, 500	7. 0	659	177
	60	5, 200	9, 600	8, 100	8. 5	500	195
	70	6, 350	16, 500	14, 000	9. 8	405	211
	80	7, 300	23, 500	20, 100	10. 9	345	224
120	20	300			2. 6	2, 324	86
	30	1, 350			4. 4	1, 219	129
	40	3, 000	1, 400	1, 200	6. 1	798	162
	50	4, 800	6, 500	5, 500	7. 7	572	187
	60	6, 250	14, 700	12, 500	9. 3	439	207
	70	7, 500	24, 100	20, 600	10. 8	352	224
	80	8, 550	33, 100	28, 600	12. 0	303	238
130	20	400			3. 0	1, 815	89
	30	1, 700			4. 9	1, 030	135
	40	3, 700	3, 100	2, 600	6. 8	680	170
	50	5, 600	9, 900	8, 400	8. 5	496	196
	60	7, 200	21, 100	18, 000	10. 2	380	217
	70	8, 600	32, 400	27, 900	11. 8	310	235
	80	9, 700	42, 600	37, 000	13. 1	266	249
140	20	500			3. 4	1, 460	92
	30	2, 100	400	300	5. 5	865	140
	40	4, 300	5, 400	4, 500	7. 4	585	177
	50	6, 350	14, 600	12, 400	9. 3	430	204
	60	8, 150	27, 800	23, 800	11. 1	337	226
	70	9, 650	40, 600	35, 200	12. 8	274	244
	80	10, 850	52, 200	45, 700	14. 3	232	259
150	20	650			3. 8	1, 210	95
	30	2, 500	1, 100	900	6. 0	735	144
	40	4, 900	7, 700	6, 500	8. 0	510	182
	50	7, 050	20, 000	17, 000	10. 1	377	210
	60	9, 000	34, 300	29, 600	12. 0	296	232
	70	10, 550	48, 700	42, 500	13. 8	242	251
	80	11, 900	61, 100	54, 300	15. 4	207	266
160	20	800			4. 2	1, 012	97
	30	2, 900	1, 800	1, 500	6. 5	640	147
	40	5, 500	10, 600	9, 000	8. 7	445	186
	50	7, 700	26, 000	22, 200	10. 9	331	214
	60	9, 750	41, 700	36, 200	12. 9	261	237
	70	11, 400	57, 000	50, 000	14. 8	214	256
	80	12, 850	70, 000	62, 100	16. 6	182	271
170	20	950			4. 5	880	98
	30	3, 250	3, 100	2, 600	7. 0	555	150
	40	6, 000	14, 000	11, 900	9. 4	385	189
	50	8, 300	31, 800	27, 400	11. 8	290	217
	60	10, 400	49, 000	42, 800	14. 0	228	241
	70	12, 150	64, 600	57, 200	16. 0	186	260
	80	13, 700	78, 400	70, 000	17. 9	159	276

See footnotes at end of table.

TABLE 4.—*Growth and yield for fully stocked, unmanaged stands of Douglas-fir*—Continued

Site index	Age in years	Total merchantable volume per acre			Average diameter in inches	Total number of trees per acre	Total square feet of basal area per acre
		Cubic feet [1]	Board feet [2] (International rule)	Board feet [2] (Scribner rule)			
180	20	1, 100			4. 9	756	99
	30	3, 600	4, 000	4, 000	7. 6	483	152
	40	6, 400	18, 200	15, 500	10. 2	335	191
	50	8, 850	37, 700	32, 700	12. 8	248	220
	60	11, 050	56, 000	49, 300	15. 2	195	244
	70	12, 850	72, 500	64, 600	17. 5	160	264
	80	14, 500	86, 700	78, 000	19. 6	136	280

[1] Volume of all stems more than 5 inches DBH (diameter at breast height) to a 4-inch top diameter inside bark.
[2] Volume of all stems 12 inches and larger DBH to a top diameter of 8 inches.

Erosion hazard is rated according to the risk of erosion in well-managed woodland not protected by special practices. The hazard is *slight* if there is no special problem. It is *moderate* if there would be a moderate loss of soil if runoff is not controlled and the vegetative cover is not adequate for protection. The hazard is *severe* if steep slopes, rapid runoff, and past erosion make the soil susceptible to severe erosion, and intensive management, special equipment, and methods of operation must be planned to minimize soil deterioration.

Windthrow hazard, or wind firmness, is rated according to the ability of the soil to support trees during periods of high winds. A rating of *slight* indicates that trees are not expected to be blown down in commonly occurring winds. *Moderate* indicates that trees are stable except during short periods of excessive wetness. *Severe* indicates that the soil and tree roots do not give enough stability to keep trees from blowing over during moderate or high winds (fig. 20).

Plant competition refers to the rate of invasion of unwanted trees, shrubs, and vines after openings are made in the canopy. Competition is *slight* if it does not prevent adequate natural regeneration and early growth or interfere with the normal development of planted seedlings. Competition is *moderate* if it delays the establishment and slows the growth of seedlings, either naturally occurring or planted, but does not prevent the eventual development of a fully stocked, normal stand. Competition is *severe* if it prevents adequate restocking, either natural or artificial, without intensive preparation of the site and without special maintenance practices, including weeding.

Equipment limitations refer to soil characteristics and topographic features that restrict or prohibit the use of conventional equipment for planting and harvesting wood crops, for constructing roads, for controlling unwanted vegetation, and for controlling fires. The limitation is *slight* if there is little or no restriction on the type of equipment that can be used or the time of year that equipment can be used. The limitation is *moderate* if the use of equipment is restricted by one or more unfavorable characteristics, such as slope, stones, or other obstructions, seasonal wetness, instability, or risk of injury to roots of trees. The limitation is *severe* if special equipment is needed or the use of such equipment is severely restricted by one or more unfavorable soil characteristics.

Wildlife and Fish [3]

Beaver, deer, mourning dove, wild duck, geese, ring-necked pheasant, bandtailed pigeon, and many species of nongame birds are common throughout the area. Black bear, elk, and blue and ruffed grouse inhabit the higher parts of the Cowlitz Area. There were about 45 farm ponds in the Area at the time of this survey and many other suitable sites for ponds.

In addition to the information in this section, the local office of the Soil Conservation Service provides practical help to landowners in planning, establishing, and improving habitat for wildlife or fish.

A summary of representative food and habitat needs of the more important kinds of wildlife and fish in the Cowlitz Area follows. The climate is such that cover generally is available or can be grown quickly.

Black bears are largely vegetarians. They feed on fruits, such as apples, bearberry, blackberries, blueberries, cascara, cherries, and salmonberry. They also eat honey, insects, garbage, fish, rodents, and other mammals. Bears can be found in any large wooded part of the Area.

Beavers eat only vegetation, mostly bark, roots, grain, and green plants, such as alder, corn, vine maple, water lilies, and willows. The chief feeding areas are within 150 feet of water. These animals are confined to areas where they can make dams that impound water and provide suitable homes for rearing their young.

Deer eat forage of grasses, legumes, forbs, and woody plants, and some fruits and grain. Choice foods include alfalfa, apples, barley, bearberries, clover, corn, oats, salmonberry, and wheat. Brush or woodland is essential for cover.

Mourning doves eat barnyardgrass, corn, oats, and wheat. They eat no insects, green leaves, or fruits. They drink water daily.

[3] By WILLARD A. CALL, soil scientist, and VERNE E. DAVIDSON and L. DEAN MARRIAGE, biologists, Soil Conservation Service.

Figure 20.—**Tipover of Douglas-fir. Roots did not anchor tree firmly enough to withstand strong winds. The soil is Minniece silt loam, 0 to 8 percent slopes. Many roots have spread horizontally in the surface layer of this soil because the water table is seasonally high.**

Ducks of several species feed on tender leaves of grass and on grain crops in winter and spring. They are especially attracted by the grains and seeds from barley, barnyardgrass, corn, oats, smartweed, and wheat. The seeds are most attractive when covered with a few inches of water.

Elk eat alfalfa, salmonberry, and willow and the forage of grasses, shrubs, trees, and various herbaceous plants.

Geese eat grain and the tender grasses. Among other choice foods are alfalfa, barley, barnyardgrass, clover, corn, oats, and wheat. They feed in the uplands and wetlands that provide open areas and attractive foods. Their daytime and nighttime resting areas are on or at the edges of ponds, lakes, and streams.

Blue and ruffed grouse are birds of open woodland areas. Choice foods include fruits, seeds, leaves, and buds of apple, bearberry, blackberries, blueberries, cascara, cherries, clovers, corn, Douglas-fir, madrone, and willows.

Ring-necked pheasant are best adapted to grain fields and the adjacent cover. Choice foods are the grains of barley, corn, oats, and wheat. They also eat some fruits sparingly. Good cover is provided by cornfields and standing stalks, cattail marshes, fence-row vegetation, and similar grassy or brushy areas.

Band-tailed pigeon prefer seeds and fruits of alder, barley, cascara, cherries, corn, Pacific dogwood, madrone, oats, salmonberry, and a few other fruits. Their roosting areas are in woodlands.

Nongame birds of different species have different food preferences. Several species eat nothing but insects. Others eat seeds or fruits, and some of these consume insects also. Several species prosper in cropland, and others inhabit woodlands, brushy areas, or the margins of ponds, lakes, and streams.

The principal species of anadromous fish in the Cowlitz Area, excluding the main stream of the Columbia River, are chinook, silver coho, blueback, chum salmon, steelhead trout, and smelt. One or more species of these fish inhabit all of the major unobstructed streams that provide suitable habitat. Anadromous fish require cold

Figure 21.—**Recreation farm pond built in Olympic silt loam, 2 to 8 percent slopes. This pond is stocked with fish. It can also be used for fire prevention and irrigation.**

water (65° F. and below) of good quality, clean gravel beds to spawn in, pools and riffles for the young to rear in, and free access to and from the Columbia River. Most streams in the Area are suited to the natural propagation of anadromous species. Keeping the migratory routes to and from the spawning and rearing areas open is the principal problem.

Major runs of salmon and steelhead trout pass through the part of the Columbia River that borders the Cowlitz Area to upstream spawning grounds in Washington, Oregon, and Idaho. Substantial numbers are harvested by sports and commercial fishermen in this stretch of stream. Other species of lesser importance in the Columbia River are shad, smelt, sturgeon, and lamprey.

The principal species of cold water (below 65° F.) resident game fish is rainbow trout. It is present in unpolluted streams, lakes, and ponds (fig. 21) that have a year-round supply of cold water. A stream that has riffles and pools and a gravel bottom produces more aquatic food for trout than does a muddy stream that has a sand or silt bottom. Rainbow trout thrive in lakes and ponds, but unless tributary streams and spawning gravels are present, they generally do not reproduce. Introduced Kokanee (landlocked blueback salmon) are present and support a sport fishery in Lake Merwin.

Warm water (above 65° F.) species of game fish in natural waters and manmade reservoirs include bass, bluegill, crappies, and catfish. Bass feed on small fish. The choice foods of bluegill, crappies, and catfish are aquatic worms and insects and their larvae. The amount of food depends on the fertility of the water, on the nature of soils of the watershed, and somewhat on the nature of soils in the bottom of the pond. The need for

application of fertilizer to farm ponds and reservoirs has not yet been determined for the survey area.

The soils of the Cowlitz Area have been assigned to 11 wildlife groups. The soils in each group are similar and generally produce about the same kinds of food plants and protective cover for wildlife. The wildlife suitability groups in this survey area are described in the following pages. To find the soils in each group, refer to the "Guide to Mapping Units" at the back of this survey.

WILDLIFE GROUP 1

This group consists of soils on flood plains, old terraces, and uplands. These soils are moderately well drained to poorly drained and are slowly to very slowly permeable. The surface layer is silt loam or silty clay loam. Slopes are 0 to 15 percent.

These soils make up about 6 percent of the survey area. All can be tilled. Some are farmed, but much of the acreage is forest. Many of the choice food plants for wildlife can be produced on these soils.

The soils on flood plains provide desirable habitat for wetland species of wildlife. Favorable sites for ponds are on uplands and old terraces. Cultivated and cleared areas produce apples, barley, barnyardgrass, clover, corn, oats, ryegrass, smartweed, and wheat. Brushy and forested areas are mainly alder, Oregon ash, blackberry, cascara, cherry, Douglas-fir, maple, salal, salmonberry, and willow.

WILDLIFE GROUP 2

This group consists of soils on flood plains and terraces. These soils are well drained and somewhat excessively drained and moderately rapidly to moderately slowly permeable. The surface layer is mostly silt loam, but in places it is fine sandy loam. Slopes are 0 to 30 percent.

These soils make up about 4 percent of the survey area. All can be tilled. About half the acreage is now farmed, and the rest is forest.

These soils produce many choice plants for wildlife. Those on flood plains along streams and sloughs provide desirable habitat for all wetland species of wildlife. Terraces provide favorable sites for ponds. Cultivated and cleared areas produce alfalfa, apples, barley, barnyardgrass, clover, corn, oats, ryegrass, and wheat. Brushy and wooded areas are mainly red alder, Oregon ash, blackberry, cascara, cherry, Douglas-fir, maple, salal, salmonberry, and willow.

WILDLIFE GROUP 3

This group consists of soils on flood plains and old terraces. These soils are somewhat poorly drained to poorly drained and are slowly to very slowly permeable. The surface layer is silt loam or silty clay loam. Most of these soils are underlain by clay. Slopes are 0 to 40 percent.

These soils make up about 3 percent of the survey area. Most can be tilled. Part of the acreage is farmed, but most of it is forest.

Streams and ponds provide good habitat for all wetland birds and animals. The soils produce many of the choice foods for wildlife. Cleared and cultivated soils grow barley, barnyardgrass, clover, oats, ryegrass, smartweed, and wheat. Brushy and forested areas are mainly Douglas-fir, red alder, Oregon ash, maple, cascara, cherry, blackberry, salal, salmonberry, and willow.

WILDLIFE GROUP 4

This group consists of soils on uplands and terraces. These soils are moderately well drained to well drained. Permeability is moderate to very slow. The surface layer is silt loam, gravelly silt loam, or gravelly loam. Slopes are 0 to 20 percent.

These soils make up about 20 percent of the survey area. All can be tilled. Part of the acreage is farmland, but most of it is forest.

Cultivated crops that provide food for wildlife include apples, barley, clover, corn, oats, ryegrass, and wheat. Brushy areas and forests are mainly red alder, blackberry, cascara, cherry, Pacific dogwood, Douglas-fir, maple, salal, salmonberry, and willow. The many perennial streams and the potential for many good pond sites can attract all wetland species of animals and birds.

WILDLIFE GROUP 5

This group consists of very deep soils on uplands and shallow flood plains. These soils are somewhat excessively drained to well drained, and permeability is very rapid to moderate. The surface layer is silt loam, gravelly silt loam, loam, to gravelly loam. Slopes are 0 to 20 percent.

These soils make up about 2 percent of the survey area. They receive 70 to 120 inches of precipitation annually. Only a small acreage is cultivated.

Crops important as food for wildlife include barley, clover, oats, ryegrass, and wheat. Brushy areas and forests are mainly red alder, blackberry, cascara, cherry, Douglas-fir, maple, Pacific dogwood, salal, salmonberry, and willow. The perennial streams and lakes attract all wetland species of birds and animals.

WILDLIFE GROUP 6

The one land type in this group, Rock land, is shallow, rocky, and well drained to excessively drained. Downward penetration of roots and water is restricted because the soil material is shallow over bedrock. The bedrock is shattered in places. Slopes are 3 to 70 percent.

Rock land makes up about 1 percent of the survey area. None of it is cultivated. Food plants for birds and animals in the brushy and forested areas are red alder, blackberry, cascara, Douglas-fir, madrone, maple, salal, salmonberry, and willow.

WILDLIFE GROUP 7

This group consists of soils on uplands and old terraces. Most of these soils are well drained and moderately slowly permeable. In most places, downward penetration of roots and water is not restricted. The surface layer is silt loam, gravelly silt loam, cobbly silt loam, or gravelly loam. Slopes range from 0 to 60 percent but are mostly 20 to 50 percent.

These soils make up about 48 percent of the survey area. Most of the acreage is forest or cut-over brushland.

Food plants include red alder, blackberry, cascara, cherry, Douglas-fir, maple, Pacific dogwood, salal, salmonberry, and willow.

WILDLIFE GROUP 8

This group consists of soils on uplands. These soils are well drained and somewhat excessively drained, and permeability is moderate to moderately rapid. The surface layer is cobbly silt loam, silt loam, or loam. Slopes are 3 to 50 percent. Elevations range from 50 to 2,700 feet.

These soils make up about 8 percent of the survey area. None are farmed. Most of the acreage is cutover brushland or forest.

Wildlife food plants include red alder, bearberry, blueberry, cherry, Douglas-fir, maple, salal, salmonberry, and willow.

WILDLIFE GROUP 9

This group consists of soils on uplands and flood plains. These soils are excessively drained to somewhat excessively drained. Permeability is rapid to very rapid. The surface layer is gravelly loamy sand, gravelly sandy loam, loamy sand, or fine sandy loam. Slopes are 0 to 60 percent.

These soils make up about 3 percent of the survey area. None are farmed. Wildlife food plants grow in cut-over brush land and forests. They include red alder, bearberry, blackberry, cascara, cherry, Douglas-fir, maple, salal, and willow.

WILDLIFE GROUP 10

The group consists of excessively drained soils on flood plains. Permeability is very rapid. These soils are generally near the larger streams. In many places they occur as small, long, narrow areas bordering stream and river channels or in recently abandoned streambeds. In places they are frequently flooded and reworked. The surface layer is loamy fine sand underlain by sandy subsoil or by stream deposits of poorly assorted sandy gravel or cobblestones. Slopes range from 0 to 8 percent but are mostly about 2 percent.

These soils make up slightly more than 1 percent of the survey area. A small acreage is used for pasture, but most is in brush and trees.

Wildlife food plants include red alder, Oregon ash, bearberry, blackberry, clover, broadleaf maple, ryegrass, and willow.

WILDLIFE GROUP 11

The one soil in this group, Semiahmoo peat, is a nearly level, very poorly drained, fibrous peat bog. It occurs in swamps and marshes and on the borders of lakes where fresh-water marsh vegetation flourishes. None of the acreage is cultivated.

This soil is generally partly covered with water. It attracts all wetland species of birds and animals. Wildlife food plants include Oregon ash, barnyardgrass, smartweed, willow, and water lily.

Engineering [4]

Some soil properties are of special interest to engineers because they affect the construction and maintenance of roads, airports, pipelines, building foundations, facilities for water storage, erosion control structures, drainage systems, and sewage disposal systems. Among the properties most important to engineers are permeability, strength, consolidation characteristics, texture, plasticity, and soil reaction. Depth to unconsolidated materials and topography are also important.

Information concerning these and related soil properties is given in tables 5 and 6. The estimates and interpretations in these tables can be used to—

1. Make studies that will aid in selecting and developing industrial, commercial, residential, and recreational sites.
2. Make preliminary estimates of the engineering properties of soils in planning farm drainage systems, ponds, irrigation systems, terraces, waterways, and diversion terraces.
3. Make preliminary evaluations of soil conditions that will aid in selecting sites for highways, airports, pipelines, and other utilities, and in planning detailed investigations at selected locations.
4. Locate probable sources of gravel, sand, rock, peat, and other construction material.
5. Correlate performance of engineering structures with soil mapping units to develop information that will be useful in planning engineering practices and in designing and maintaining such structures.
6. Evaluate runoff and sedimentation when designing and planning the construction of dams, channels, and other water-control structures.
7. Supplement other publications, such as maps, reports, and aerial photographs, that are used in preparation of engineering reports for a specific area.
8. Develop other preliminary estimates for construction purposes pertinent to the particular area.

The engineering interpretations reported here do not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads or excavations deeper than the depths reported (ordinarily about 5 feet). Even in these situations, however, the soil map is useful in planning more detailed field investigations and in indicating the kinds of problems that may be expected.

Some of the terms used by soil scientists have special meanings in soil science that may not be familiar to engineers. These terms are defined in the Glossary.

Engineering classification systems

The two systems most commonly used in classifying soils for engineering are the systems approved by the American Association of State Highway Officials (AASHO) and the Unified system.

The AASHO system (*1*) is used to classify soils according to those properties that affect use in highway construction. In this system all soil material is classified in seven principal groups. The groups range from A–1, which consists of soils that have the highest bearing strength and are the best soils for subgrade, to A–7, which consists of soils that have the lowest strength when wet.

[4] CHARLES ROBERT NESS, area engineer, Soil Conservation Service, helped prepare this section.

TABLE 5.—*Estimates of soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in for referring to other series that appear in the first column of

Soil series and map symbols	Depth to—		Depth from surface (typical profile)	Classification		
	Bedrock	Seasonal high water table		Dominant USDA texture	Unified	AASHO
	Ft.	*Ft.*	*In.*			
Bear Prairie: BpC, BpD, BpD2, BpE	>5	(1)	0–77	Silt loam	CL	A–6
Camas: Ca	>5	(1)	0–22	Cobbly loam	ML or CL	A–4
			22–60	Very cobbly loamy sand	SM	A–1
Caples: Ce, Ch	>5	1–3	0–72	Silty clay loam	CL	A–7
Cinebar:						
CmB	>5	(1)	0–32	Loam	ML	A–4
			30–56	Sandy loam	SM	A–4
			56–72	Loamy coarse sand	SM	A–2
CoB, CoC, CoD, CoE	>5	(1)	0–42	Gravelly silt loam	ML or CL	A–4
			42–75	Silt loam	ML or CL	A–4
CnC, CnD	>5	(1)	0–72	Silt loam	ML	A–4
Cispus: CsC, CsE	>5	(1)	0–60	Gravelly loamy sand	SM	A–1
Clato:						
Cl	>5	(1)	0–69	Silt loam	ML or CL	A–4
Cv	>5	(2) 4	0–32	Loam	ML	A–4
			32–60	Very gravelly coarse sand	GP–GM	A–1
Cowceman:						
CwC	>5	2–3	0–24	Silt loam	CL	A–6
			24–70	Clay	MH	A–7
CxD	>5	1–2	0–70	Clay	MH	A–7
CyB	>5	0–1	0–60	Clay	MH	A–7
Gee: GeB, GeC, GeD	>5	2–4	0–12	Silt loam	CL	A–6
			12–53	Silty clay loam	CL	A–6
			53–72	Clay	CH	A–7
Germany:						
GmB, GmC, GmD, GmE	>5	(1)	0–72	Heavy silt loam	CL	A–6
GnD, GnE	>5	(1)	0–72	Cobbly silt loam	ML or CL	A–6
Godfrey: Go, Gr	>5	0–2	0–27	Silty clay loam	CL	A–6
			27–60	Sandy clay and clay	CH or MH	A–7
Hillsboro: HlD	>5	(1)	0–28	Silt loam	CL	A–4
			28–43	Very fine sandy loam	ML	A–4
			43–78	Fine sand	SP–SM	A–3
Kalama: KaB, KaC, KaD, KaE	>5	(1)	0–23	Gravelly clay loam	ML or CL	A–6
			23–34	Gravelly sandy clay	SC	A–7
			34–72	Very gravelly clay loam	GC or SC	A–2
Kelso: KeB, KeC, KeD, KeE	>5	(1)	0–60	Silt loam	CL	A–6
*Loper: LbC, LbD, LbD2, LbE	3–5	(1)	0–34	Cobbly and gravelly silt loam.	ML	A–4
For Bear Prairie part, refer to Bear Prairie series.			34	Shattered rocks.		
Made land: Md. No valid estimates can be made.						
McBee: Mb	>5	2–5	0–13	Silty clay	MH	A–7
			13–60	Silty clay loam	CL	A–6
Mart: MrB, MrC, MrD, MrE	3.5–>5	(1)	0–42	Silty clay loam	CL	A–6
			42–60	Very gravelly silty clay loam.	GC	A–6

See footnotes at end of table.

significant in engineering

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions this table. The symbol > means more than; < means less than]

Coarse fraction greater than 3 inches in diameter	Percentage passing sieve—				Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity	
	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)					Uncoated steel	Concrete
Pct.					*In./hr.*	*In./in. of soil*	*pH*			
0	95–100	90–95	85–95	80–90	0. 6–2. 0	0. 19–0. 21	5. 1–5. 5	Low	High	Moderate.
15–25	70–80	65–75	55–65	50–60	2. 0–6. 3	0. 11–0. 15	5. 6–6. 0	Low	Low	Moderate.
50–60	55–70	40–50	25–35	10–15	>20. 0	0. 03–0. 05	5. 6–6. 0	Low	Low	Moderate.
0	95–100	95–100	90–95	80–90	0. 06–0. 2	0. 19–0. 21	5. 6–6. 0	High	High	Moderate.
0	90–100	90–95	85–90	55–70	0. 6–2. 0	0. 16 0. 18	5. 1–5. 5	Low	High	Moderate.
0	90–100	85–95	60–70	35–45	2. 0–6. 3	0. 11–0. 13	5. 6–6. 0	Low	High	Moderate.
0	90–100	85–95	50–65	15–30	6. 3–20. 0	0. 06–0. 08	5. 1–5. 5	Low	Moderate	Moderate.
0	90–95	60–70	55–65	50–60	0. 6–2. 0	0. 14–0. 16	5. 6–6. 5	Low	High	Moderate.
0	90–95	85–95	80–90	60–80	0. 6–2. 0	0. 19–0. 21	6. 6–7. 3	Low	Moderate	Low.
0	90–95	85–95	80–90	65–85	0. 6–2. 0	0. 19–0. 21	5. 6–6. 5	Low	High	Moderate.
0–5	55–85	50–60	20–40	10–20	>20. 0	0. 05–0. 07	6. 1–6. 5	Low	Low	Moderate.
0	95–100	95–100	90–100	70–90	0. 6–2. 0	0. 19–0. 21	5. 6–6. 0	Low	Low	Moderate.
0–5	90–95	85–95	85–95	60–75	0. 6–2. 0	0. 16–0. 18	5. 1–6. 0	Low	Low	Moderate.
5–10	35–45	30–40	15–25	5–10	>20. 0	0. 04–0. 06	5. 6–6. 0	Low	Low	Moderate.
0	95–100	95–100	90–100	70–90	0. 6–2. 0	0. 19–0. 21	5. 1–5. 5	Low	High	Moderate.
0	95–100	95–100	90–100	75–95	<0. 06	0. 12–0. 14	5. 6–6. 0	High	High	Moderate.
0	95 100	95 100	90 100	75 95	<0. 06	0. 12–0. 14	4. 5–6. 0	High	High	Moderate.
0	95–100	95–100	90–100	75–95	<0. 06	0. 12–0. 14	5. 1–7. 3	High	High	Moderate.
0	95–100	90–95	85–95	70–90	0. 6–2. 0	0. 19–0. 21	5. 6–6. 0	Low	Moderate	Moderate.
0	90–95	90–95	85–95	85–90	0. 06–0. 20	0. 19–0. 21	5. 1–5. 5	Moderate	High	Moderate.
0	95–100	95–100	90–100	75–95	<0. 06	0. 06–0. 08	4. 5–5. 0	High	High	High.
0–5	90–95	90–95	85–95	80–90	0. 6–2. 0	0. 19–0. 21	4. 5–5. 5	Low	High	Moderate.
15–25	65–80	60–75	55–70	50–60	0. 6–2. 0	0. 14–0. 16	4. 5–5. 5	Low	High	Moderate.
0–5	95–100	95–100	90–95	85–90	0. 2–0. 6	0. 19–0. 21	4. 5–6. 0	Moderate	High	Moderate.
0–5	95–100	95–100	90–95	70–80	<0. 06	0. 06–0. 08	6. 6–7. 3	High	High	Low.
0	90–95	90–95	85–95	70–90	0. 6–2. 0	0. 19 0. 21	5. 6–7. 3	Moderate	Moderate	Moderate.
0–5	90–95	90–95	80–90	55–65	0. 6–2. 0	0. 15–0. 17	5. 6–7. 3	Moderate	Moderate	Moderate.
0–5	90–95	90–95	55–70	5–10	6. 3–20. 0	0. 05–0. 07	5. 6–7. 3	Low	Low	Low.
5–10	85–95	65–80	60–70	55–65	0. 2–0. 6	0. 13–0. 15	5. 1–6. 5	Low	Moderate	Moderate.
5–10	80–90	60–75	50–70	35–45	0. 06–0. 2	0. 10–0. 12	5. 6–6. 0	Moderate	High	Moderate.
5–15	50–65	35–45	30–40	25–30	0. 2–0. 6	0. 08–0. 10	5. 6–6. 0	Low	Moderate	Moderate.
0–5	95–100	95–100	90–100	70–90	0. 06–0. 2	0. 19 0. 21	5. 6–6. 5	Moderate	Moderate	Moderate.
10–30	70–90	60–80	55–70	50–60	0. 6–2. 0	0. 13–0. 15	4. 5–5. 5	Low	High	High.
5–10	85–90	85–90	80–90	75–85	0. 2–0. 63	0. 15–0. 17	5. 6–6. 0	Moderate	High	Moderate.
5–10	85–90	85–90	80–90	75–85	0. 63–2. 0	0. 19–0. 21	4. 5–5. 5	Moderate	High	High.
0	95–100	90–95	75–85	70–80	0. 2–0. 63	0. 19–0. 21	5. 1–6. 5	Moderate	Moderate	Moderate.
5 10	55–65	45–55	40–50	35–45	0. 2–0. 63	0. 08–0. 10	4. 5–5. 0	Low	High	High.

TABLE 5.—*Estimates of soil*

Soil series and map symbols	Depth to—		Depth from surface (typical profile)	Classification		
	Bedrock	Seasonal high water table		Dominant USDA texture	Unified	AASHO
	Ft.	*Ft.*	*In.*			
Minniece:						
MtB, MtC	>5	1–2	0–13	Heavy silt loam	CL	A–6
			13–60	Silty clay and heavy silty clay loam.	MH	A–7
MvA	>5	0–1	0–17	Heavy silt loam and silty clay loam.	CL	A–6
			17–56	Sandy clay loam	SC	A–6
			56–62	Coarse sandy loam	SM	A–2 or A–4
Newberg:						
Ne	>5	4–>6.0	0–60	Stratified fine sandy loam, loamy sand, fine sand, and silt loam.	SM	A–4
Nw	>5	1–2	0–62	Stratified silt loam, silt, fine sandy loam, loamy very fine sand.	ML	A–4
Olequa:						
OeB, OeC, OeD, OeE	>5	(1)	0–43	Silt loam and silty clay loam.	CL	A–7
			43–72	Silt loam	ML	A–4
OlB, OlC	>5	2–3	0–25	Silt loam	ML	A–4
			25–48	Silty clay loam	CL	A–7
			48–62	Silty clay	CH	A–7
Olympic:						
OmB, OmC, OmD, OmE	3½–>6	(1)	0–20	Silt loam	CL	A–6
			20–48	Silty clay loam	CL	A–7
			48	Decomposing basalt		
OpB, OpC, OpD, OpE	3½–>5	(1)	0–62	Gravelly silty clay loam	CL	A–7
OyC	3½–>5	(1)	0–62	Very cobbly silty clay loam.	CL	A–7
Pilchuck: PcB	>5	(1)	0–60	Medium sand	SP–SM	A–1
Riverwash: Rh. No valid estimates can be made.						
Rock land: Ro. No valid estimates can be made.						
Rose Valley:						
RvB, RvC, RvD	>5	1–2	0–14	Silt loam	ML or CL	A–4
			14–30	Silty clay loam	CL	A–7
			30–62	Silty clay	CH	A–7
RyB	>5	0–1	0–10	Silt loam	CL	A–6
			10–60	Clay	CH	A–7
Sara: SaB, SaC, SaD, ScB	>5	3–4	0–28	Silty clay loam	CL	A–6
			28–61	Silty clay and sandy clay	CH	A–7
Sauvola: SlB, SlC, SlD	>5	3–5	0–12	Loam	ML	A–4
			12–30	Silty clay loam and silty clay.	CL	A–7
			30–60	Gravelly sandy loam	SM	A–2
Seaquest: SmB, SmC, SmD	>5	(1)	0–64	Silty clay loam and sandy clay loam.	CL	A–6

See footnotes at end of table.

properties significant in engineering—Continued

Coarse fraction greater than 3 inches in diameter	Percentage passing sieve—				Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity	
	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)					Uncoated steel	Concrete
Pct.					*In./hr.*	*In./in. of soil*	*pH*			
0–5	90–95	85–90	80–90	70–85	0. 6–2. 0	0. 19–0. 21	4. 5–5. 5	Moderate	High	High.
0–5	90–95	85–90	80–90	70–85	<0. 06	0. 06–0. 08	5. 1–5. 5	High	High	Moderate.
0–5	95–100	95–100	90–100	75–90	0. 06–0. 2	0. 19–0. 21	5. 6–6. 0	Moderate	High	Moderate.
0–5	95–100	90–100	70–80	35–50	0. 06–0. 2	0. 14–0. 16	5. 1–6. 0	Moderate	High	Moderate.
0–5	95–100	90–95	55–65	30–40	2. 0–6. 3	0. 11–0. 13	5. 6–6. 0	Low	High	Moderate.
0–5	95–100	95–100	60–70	35–45	2. 0–6. 3	0. 13–0. 15	5. 6–7. 3	Low	Low	Low.
0–5	95–100	95–100	70–85	50–60	0. 2–0. 63	0. 17–0. 21	5. 1–7. 3	Low	Moderate to high.	Moderate.
0–5	95–100	95–100	95–100	85–95	0. 2–0. 6	0. 19–0. 21	4. 5–6. 5	Moderate	Moderate	Moderate.
0–5	95–100	95–100	90–100	70–90	0. 6–2. 0	0. 19–0. 21	5. 6–6. 0	Moderate	Moderate	Moderate.
0–5	95–100	95–100	90–95	75–90	0. 6–2. 0	0. 19–0. 21	4. 6–5. 5	Low	High	Moderate.
0–5	95–100	85–90	85–90	75–85	0. 06–0. 2	0. 19–0. 21	5. 1–5. 5	Moderate	High	Moderate.
0–5	95–100	85–90	80–90	75–85	<0. 06	0. 06–0. 08	5. 1–5. 5	Moderate	High	Moderate.
0–5	90–95	90–95	85–90	70–90	0. 6–2. 0	0. 19–0. 21	6. 1–6. 5	Low	High	Low.
0–5	90–95	90–95	85–90	75–90	0. 2–0. 6	0. 18–0. 20	5. 1–6. 0	High	High	Moderate.
5–15	60–85	60–80	55–70	50–65	0. 2–0. 6	0. 14–0. 16	5. 1–5. 5 5. 1–6. 5	Low to moderate.	High	Moderate.
50–60	70–90	60–80	55–70	50–65	0. 2–0. 6	0. 08–0. 10	5. 1–6. 5	Low	High	Moderate.
0	95–100	90–95	40–50	5–10	>20. 0	0. 05–0. 07	5. 6–6. 5	Low	Low	Moderate.
0–5	90–95	90–95	80–90	70–85	0. 6–2. 0	0. 19–0. 21	5. 6–6. 0	Low	High	Moderate.
0–5	90–95	90–95	80–90	70–85	0. 06–0. 2	0. 19–0. 21	5. 6–6. 0	Low	High	Moderate.
0–5	90–95	90–95	80–90	70–85	<0. 06	0. 06–0. 08	5. 6–6. 5	High	High	Moderate.
0–5	95–100	85–90	85–90	70–80	0. 6–2. 0	0. 19–0. 21	5. 1–5. 5	Low	High	Moderate.
0–5	90–95	85–90	85–90	75–85	<0. 06	0. 06–0. 08	4. 5–6. 0	High	High	High.
0–5	95–100	90–95	80–95	70–95	0. 06–0. 2	0. 19–0. 21	5. 1–6. 0	Moderate	High	Moderate.
0–5	95–100	90–95	80–95	60–90	<0. 06	0. 06–0. 08	4. 5–5. 5	High	High	Moderate.
0	95–100	95–100	85–95	50–70	0. 06–2. 0	0. 16–0. 18	5. 6–6. 0	Low	High	Moderate.
0	95–100	90–100	85–95	70–80	0. 06–0. 2	0. 16–0. 18	4. 5–6. 0	High	High	High.
0–5	95–100	65–70	60–65	20–30	0. 06–0. 2	0. 07–0. 09	4. 5–5. 0	Low	High	High.
0	100	90–95	80–90	70–80	0. 2–0. 6	0. 16–0. 18	4. 5–6. 9	Moderate	High	High.

TABLE 5.—*Estimates of soil*

Soil series and map symbols	Depth to—		Depth from surface (typical profile)	Classification		
	Bedrock	Seasonal high water table		Dominant USDA texture	Unified	AASHO
	Ft.	*Ft.*	*In.*			
Semiahmoo: Sp	>5	(2)	0–48	Peat, muck	Pt	
			48–84	Muck and silty clay	Pt and CH	
Sifton: SrB	>5	(1)	0–21	Sandy loam	SM	A–2 or A–4.
			21–60	Sandy gravel	SP–SM	A–1
Snohomish: Ss	>5	0–1	0–15	Silty clay loam	CL	A–7
			15–61	Peat, muck	Pt	
Speelyai: SyB, SyE	>5	(1)	0–11	Gravelly sand	SP–SM	A–3
			11–60	Weakly cemented very gravelly sand.	SP–SM	A–1
Toutle: ToB, ToD, TuB, TuD	>5	(1)	0–36	Stratified loamy sand, sandy loam, and very fine sandy loam.	SM	A–4
			36–60	Gravelly medium sand	SP–SM	A–1
TtB	>5	(1)	0–36	Stratified gravelly loamy sand, sandy loam, and fine sandy loam.	SM	A–2
			36–60	Gravelly medium sand	SP–SM	A–1
Vader: VaD, VaE	3½–>6	(1)	0–27	Loam	ML	A–4
			27–54	Loamy fine sand	SM	A–1
			54–68	Very gravelly fine sand	GP–GM	A–1

[1] No seasonal high water table within a depth of 5 feet.
[2] In some places.

properties significant in engineering—Continued

Coarse fraction greater than 3 inches in diameter	Percentage passing sieve—				Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity	
	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)					Uncoated steel	Concrete
Pct.					*In./hr.*	*In./in. of soil*	*pH*			
					0. 6–2. 0	0. 40–0. 50	4. 5–5. 0	High shrink, low swell.	High	High.
					0. 06–0. 2	0. 17–0. 20	4. 5–5. 0	High shrink, low swell.	High	High.
5–10	85–95	50–75	34–45	30–40	6. 3–20. 0	0. 07–0. 09	5. 6–6. 5	Low	Low	Moderate.
10–15	65–80	35–45	20–30	5–10	>20. 0	0. 03–0. 05	5. 6–6. 0	Low	Low	Moderate.
0–2	95–100	95–100	95–100	85–95	0. 06–0. 2	0. 19–0. 21	5. 1–6. 5	Moderate	High	Moderate.
					2. 0–6. 3	0. 40–0. 50	5. 6–6. 5	High shrink, low swell.	High	Moderate.
0–10	75–80	55–75	50–70	5–10	>20. 0	0. 03–0. 05	4. 5–7. 3	Low	Low	Moderate.
5–15	60–75	35–45	20–50	5–10	0. 06–0. 2		5. 5–6. 0			
0–5	90–95	85–95	50–70	35–45	6. 3–20. 0	0. 08–0. 12	5. 6–7. 3	Low	Low	Low.
0–5	55–90	50–85	30–50	5–10	>20. 0	0. 04–0. 06	5. 1–7. 3	Low	Low	Low.
0–5	70–90	50–85	40–60	20–30	6. 3–20. 0	0. 06–0. 08	5. 6–7. 3	Low	Low	Low.
0–5	55–90	50–75	30–50	5–10	>20. 0	0. 04–0. 06	5. 1–7. 3	Low	Low	Low.
0–5	90–95	80–90	70–85	60–80	2. 0–6. 3	0. 16–0. 18	4. 5–5. 5	Low	Low	High.
0–5	90–95	85–95	30–50	10–20	6. 3–20. 0	0. 08–0. 10	4. 5–5. 0	Low	Low	High.
0–5	20–35	15–30	10–25	5–10	>20. 0	0. 04–0. 06	5. 1–5. 5	Low	Low	High.

[3] At or near the surface.

TABLE 6.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in referring to other series that appear

Soil series and map symbols	Suitability as source of—			Soil features affecting—
	Topsoil [1]	Sand and gravel	Road fill	Highway location
Bear Prairie: BpC, BpD, BpD2, BpE	Good	Unsuitable: excessive fines.	Poor: low shear strength; high susceptibility to frost action; A–6.	3 to 50 percent slopes; high susceptibility to frost action.
Camas: Ca	Unsuitable: excessive cobblestones.	Unsuitable: excessive fines.	Good below a depth of 22 inches.	0 to 3 percent slopes; subject to flooding.
Caples: Ce, Ch	Fair: silty clay loam at or near the surface.	Unsuitable: excessive fines.	Poor: low shear strength; A–7.	0 to 3 percent slopes; seasonal water table at a depth of 1 to 3 feet; subject to flooding unless diked; high shrink-swell potential.
Cinebar: CmB, CnC, CnD, CoB, CoC, CoD, CoE.	Good if nongravelly. Fair if gravelly.	Unsuitable: excessive fines.	Fine: low shear strength; high susceptibility to frost action; A–4.	0 to 50 percent slopes; high susceptibility to frost action.
Cispus: CsC, CsE	Poor if gravelly; loamy sand near surface.	Unsuitable: excessive fines and pumice gravel.	Good	8 to 60 percent slopes.
Clato: Ct	Good	Unsuitable: excessive fines.	Fair: low shear strength; high susceptibility to frost action; A–4.	0 to 3 percent slopes; high susceptibility to frost action; few small areas subject to flooding.

See footnotes at end of table.

interpretations

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for in the first column of this table]

Soil features affecting—Continued					
Irrigation	Pond reservoir areas	Embankments, dikes, and levees	Terraces and diversions	Grassed waterways	Agricultural drainage
Moderate intake rate; high available water capacity; 3 to 50 percent slopes.	Moderate permeability; 3 to 50 percent slopes.	Embankments: low shear strength; medium compressibility; semipervious to impervious if compacted. Dikes and levees: generally not needed.	Moderate permeability; 3 to 50 percent slopes; slight to severe erosion hazard.	High available water capacity; 3 to 50 percent slopes; slight to severe erosion hazard.	(2).
Cobbly throughout; moderate intake rate; low available water capacity; 0 to 3 percent slopes.	Very rapid permeability; 0 to 3 percent slopes.	Cobbly throughout; pervious if compacted.	Very rapid permeability; 0 to 3 percent slopes; moderate erosion hazard from flooding.	Low available water capacity; 0 to 3 percent slopes; moderate erosion hazard from flooding.	(2).
Moderate to moderately slow intake rate; high available water capacity; 0 to 3 percent slopes.	Slow permeability; 0 to 3 percent slopes; seasonal water table at a depth of 1 to 3 feet.	Low shear strength; high compressibility; high shrink-swell potential; impervious if compacted.	Slow permeability; 0 to 3 percent slopes; no hazard to slight erosion hazard; subject to flooding unless diked.	High available water capacity; 0 to 3 percent slopes; no hazard to slight erosion hazard; subject to flooding unless diked.	Slow permeability; seasonal water table at a depth of 1 to 3 feet; subject to flooding unless diked.
Moderate intake rate; high available water capacity; 0 to 50 percent slopes.	Moderate permeability; 0 to 50 percent slopes.	Embankments: low shear strength; medium to high compressibility; semipervious to impervious if compacted. Dikes and levees: generally not needed.	Moderate permeability; 0 to 50 percent slopes; slight to severe erosion hazard.	High available water capacity; 0 to 50 percent slopes; slight to severe erosion hazard.	(2).
Moderately rapid intake rate; moderate available water capacity; 8 to 60 percent slopes.	Very rapid permeability; 8 to 60 percent slopes.	Embankments: low shear strength; slight compressibility; semipervious to pervious if compacted. Dikes and levees: generally not needed.	Very rapid permeability; 8 to 60 percent slopes; moderate to severe erosion hazard.	Moderate available water capacity; 8 to 60 percent slopes; moderate to severe erosion hazard.	(2).
Moderate intake rate; high available water capacity; 0 to 3 percent slopes.	Moderate permeability; 0 to 3 percent slopes.	Low shear strength; medium to high compressibility; semipervious if compacted.	Moderate permeability; 0 to 3 percent slopes; no hazard to slight erosion hazard.	High available water capacity; 0 to 3 percent slopes; no hazard to slight erosion hazard; few small areas subject to flooding.	(2).

TABLE 6.—*Engineering*

Soil series and map symbols	Suitability as source of—			Soil features affecting—
	Topsoil [1]	Sand and gravel	Road fill	Highway location
Cv	Good	Fair for gravel at a depth below 32 inches if washed. Unsuitable for sand: excessive gravel.	Good at a depth below 32 inches.	0 to 3 percent slopes; high susceptibility to frost action at depths above 32 inches; subject to flooding in places.
Coweeman: CwC	Good	Unsuitable: excessive fines.	Poor: low shear strength; high shrink-swell potential; A–7.	5 to 15 percent slopes; high shrink-swell potential; seasonal water table at a depth of 2 to 3 feet.
CxD	Fair: silty clay loam.	Unsuitable: excessive fines.	Poor: low shear strength; high shrink-swell potential; A–7.	8 to 30 percent slopes; high shrink-swell potential; seasonal water table at a depth of 1 to 2 feet.
CyB	Fair: silty clay loam.	Unsuitable: excessive fines.	Poor: low shear strength; high shrink-swell potential; A–7.	0 to 4 percent slopes; high shrink-swell potential; seasonal water table at a depth of 0 to 1 foot.
Gee: GeB, GeC, GeD	Good	Unsuitable: excessive fines.	Poor: low shear strength; A–6 or A–7.	0 to 40 percent slopes; moderate shrink-swell potential at depths above 53 inches; seasonal water table at a depth of 2 to 4 feet.
Germany: GmB, GmC, GmD, GmE, GnD, GnE.	Good: silt loam. Poor: cobbly silt loam.	Unsuitable: excessive fines.	Poor: low shear strength; high susceptibility to frost action; A–6.	0 to 50 percent slopes; high susceptibility to frost action.
Godfrey: Go, Gr	Fair: silty clay loam.	Unsuitable: excessive fines.	Poor: low shear strength; A–6 or A–7.	0 to 3 percent slopes; seasonal water table at a depth of 0 to 2 feet; subject to flooding in places.

See footnotes at end of table.

interpretations—Continued

Soil features affecting—Continued					
Irrigation	Pond reservoir areas	Embankments, dikes, and levees	Terraces and diversions	Grassed waterways	Agricultural drainage
Moderate intake rate; moderately high available water capacity; 0 to 3 percent slopes.	Very rapid permeability at depths below 32 inches; 0 to 3 percent slopes.	Low shear strength at depths above 32 inches; medium compressibility; semipervious if compacted. High shear strength at a depth of 32 to 60 inches; slight compressibility; pervious if compacted.	Moderate permeability at depths above 32 inches; very rapid permeability at a depth of 32 to 60 inches; 0 to 3 percent slopes; slight to moderate erosion hazard from flooding.	Moderately high available water capacity; 0 to 3 percent slopes; slight to moderate erosion hazard from flooding; subject to flooding in places.	(2).
Moderate intake rate; high available water capacity; 5 to 15 percent slopes.	Very slow permeability; 5 to 15 percent slopes; seasonal water table at a depth of 2 to 3 feet.	Low shear strength; high compressibility; high shrink-swell potential; impervious if compacted.	Very slow permeability; 5 to 15 percent slopes; slight to moderate erosion hazard.	High available water capacity; 5 to 15 percent slopes; slight to moderate erosion hazard.	Very slow permeability; seasonal water table at a depth of 2 to 3 feet.
Moderately slow intake rate; moderately high to high available water capacity; 8 to 30 percent slopes.	Very slow permeability; 8 to 30 percent slopes; seasonal water table at a depth of 1 to 2 feet.	Low shear strength; high compressibility; high shrink-swell potential; impervious if compacted.	Very slow permeability; 8 to 30 percent slopes; moderate to severe erosion hazard.	Moderately high to high available water capacity; 8 to 30 percent slopes; moderate to severe erosion hazard.	Very slow permeability; seasonal water table at a depth of 1 to 2 feet.
Moderately slow intake rate; moderately high to high available water capacity; 0 to 4 percent slopes.	Very slow permeability; 0 to 4 percent slopes; seasonal water table at a depth of 0 to 1 foot.	Low shear strength; high compressibility; high shrink-swell potential; impervious if compacted.	Very slow permeability; 0 to 4 percent slopes; no hazard to slight erosion hazard.	Moderately high to high available water capacity; 0 to 4 percent slopes; no hazard to slight erosion hazard.	Very slow permeability; seasonal water table at a depth of 0 to 1 foot.
Moderate intake rate; high available water capacity; 0 to 40 percent slopes.	Very slow permeability below a depth of 53 inches; 0 to 40 percent slopes; seasonal water table at a depth of 2 to 4 feet.	Low shear strength; high compressibility; moderate shrink-swell potential at depths above 53 inches; impervious if compacted.	Very slow permeability below a depth of 53 inches; 0 to 40 percent slopes; slight to severe erosion hazard.	High available water capacity; 0 to 40 percent slopes; slight to severe erosion hazard.	Very slow permeability at depths below 53 inches; seasonal water table at a depth of 2 to 4 feet.
Moderate intake rate; high available water capacity; 0 to 50 percent slopes; cobbly surface layer in places.	Moderate permeability; 0 to 50 percent slopes.	Low shear strength; medium compressibility; semipervious if compacted.	Moderate permeability; 0 to 50 percent slopes; slight to severe erosion hazard.	High available water capacity; 0 to 50 percent slopes; slight to severe erosion hazard.	(2).
Moderate to moderately slow intake rate; moderately high to high available water capacity; 0 to 3 percent slopes.	Very slow permeability; 0 to 3 percent slopes; seasonal water table at a depth of 0 to 2 feet.	Low shear strength; high compressibility; moderate to high shrink-swell potential; impervious if compacted.	Very slow permeability; 0 to 3 percent slopes; slight to moderate erosion hazard from flooding.	Moderately high to high available water capacity; 0 to 3 percent slopes; slight to moderate erosion hazard from flooding in places.	Very slow permeability; seasonal water table at a depth of 0 to 2 feet; subject to flooding in places.

TABLE 6.—*Engineering*

Soil series and map symbols	Suitability as source of—			Soil features affecting—
	Topsoil [1]	Sand and gravel	Road fill	Highway location
Hillsboro: HID	Good	Unsuitable: excessive fines.	Fair: low shear strength; high susceptibility to frost action; A–4.	0 to 40 percent slopes; high susceptibility to frost action; moderate shrink-swell potential.
Kalama: KaB, KaC, KaD, KaE	Fair: gravelly	Unsuitable: excessive fines.	Poor to a depth of 34 inches; low shear strength; A–6 or A–7. Good at a depth of 34 to 72 inches.	0 to 60 percent slopes; low to moderate shrink-swell potential.
Kelso: KeB, KeC, KeD, KeE	Good	Unsuitable: excessive fines.	Poor: low shear strength; high susceptibility to frost action; A–6.	0 to 50 percent slopes; high susceptibility to frost action; moderate shrink-swell potential.
*Loper: LbC, LbD, LbD2, LbE For Bear Prairie part, see Bear Prairie series.	Poor: excessive cobblestones.	Unsuitable: excessive fines.	Fair: low shear strength; A 4.	3 to 50 percent slopes; shattered rock at a depth of 34 inches.
McBee: Mb	Poor: silty clay to a depth of 13 inches.	Unsuitable: excessive fines.	Poor: low shear strength; A–7 or A–6.	0 to 3 percent slopes; seasonal water table at a depth of 2 to 5 feet; moderate shrink-swell potential.
Made land: Md. No interpretations. Material too variable.				
Mart: MrB, MrC, MrD, MrE	Good	Unsuitable: excessive fines.	Poor: low shear strength; A–6.	0 to 50 percent slopes; high susceptibility to frost action; moderate shrink-swell potential.

See footnotes at end of table.

interpretations—Continued

Soil features affecting—Continued					
Irrigation	Pond reservoir areas	Embankments, dikes, and levees	Terraces and diversions	Grassed waterways	Agricultural drainage
Moderate intake rate; high available water capacity; 0 to 40 percent slopes.	Moderate permeability to a depth of 43 inches, rapid below; 0 to 40 percent slopes.	Low shear strength; medium to high compressibility; moderate shrink-swell potential; semipervious to impervious if compacted.	Moderate permeability; 0 to 40 percent slopes; slight to severe erosion hazard.	High available water capacity; 0 to 40 percent slopes; slight to severe erosion hazard.	(2).
Moderate intake rate; high available water capacity; 0 to 60 percent slopes.	Slow permeability; 0 to 60 percent slopes.	Low shear strength; slight to medium compressibility; low to moderate shrink-swell potential; semipervious to impervious if compacted.	Slow permeability; 0 to 60 percent slopes; slight to very severe erosion hazard.	High available water capacity; 0 to 60 percent slopes; slight to very severe erosion hazard.	Slow permeability.
Moderate intake rate; high available water capacity; 0 to 50 percent slopes.	Slow permeability; 0 to 50 percent slopes.	Low shear strength; high compressibility; moderate shrink-swell potential; semipervious to impervious if compacted.	Slow permeability; 0 to 50 percent slopes; slight to very severe erosion hazard.	High available water capacity; 0 to 50 percent slopes; slight to very severe erosion hazard.	Slow permeability.
(2)	Moderate permeability; 3 to 50 percent slopes; shattered rock at a depth of 34 inches.	Embankments: low shear strength; slight to medium compressibility; semipervious when compacted. Dikes and levees: generally not needed.	(2)	(2)	(2).
Slow intake rate; high available water capacity; 0 to 3 percent slopes.	Moderately slow to moderate permeability; 0 to 3 percent slopes; seasonal water table at a depth of 2 to 5 feet.	Low shear strength; high compressibility; moderate shrink-swell potential; impervious if compacted.	Moderately slow to moderate permeability; 0 to 3 percent slopes; slight erosion hazard.	High available water capacity; 0 to 3 percent slopes; slight erosion hazard.	Moderately slow to moderate permeability; seasonal water table at a depth of 2 to 5 feet.
Moderate intake rate; high available water capacity; 0 to 50 percent slopes.	Moderately slow permeability; 0 to 50 percent slopes.	Low shear strength; high compressibility in uppermost 42 inches, slight compressibility at depths below 42 inches; moderate shrink-swell potential; semipervious to impervious if compacted.	Moderately slow permeability; 0 to 50 percent slopes; slight to severe erosion hazard.	High available water capacity; 0 to 50 percent slopes; slight to severe erosion hazard.	(2).

TABLE 6.—*Engineering*

Soil series and map symbols	Suitability as source of—			Soil features affecting—
	Topsoil [1]	Sand and gravel	Road fill	Highway location
Minniece: MtB, MtC	Good	Unsuitable: excessive fines.	Poor: low shear strength; A–6 or A–7.	0 to 25 percent slopes; seasonal water table at a depth of 1 to 2 feet; high shrink-swell potential.
MvA	Good	Unsuitable: excessive fines.	Poor: low shear strength; A–6.	0 to 3 percent slopes; seasonal water table at a depth of 0 to 1 foot; moderate shrink-swell potential.
Newberg: Ne	Good	Unsuitable: excessive fines.	Fair: low shear strength; A–4.	0 to 3 percent slopes; subject to flooding in places.
Nw	Good	Unsuitable: excessive fines.	Fair: low shear strength; high susceptibility to frost action; A–4.	0 to 3 percent slopes; high susceptibility to frost action; seasonal water table at a depth of 1 to 2 feet; subject to flooding in places.
Olequa: OeB, OeC, OeD, OeE	Good	Unsuitable: excessive fines.	Poor: low shear strength.	0 to 50 percent slopes; moderate shrink-swell potential.
OlB, OlC	Good	Unsuitable: excessive fines.	Poor: low shear strength; high susceptibility to frost action; dominantly A–7.	3 to 15 percent slopes; high susceptibility to frost action; seasonal water table at a depth of 2 to 3 feet; moderate shrink-swell potential.
Olympic: OmB, OmC, OmD, OmE	Good	Unsuitable: excessive fines.	Poor: low shear strength; high susceptibility to frost action; A–6 or A–7.	2 to 50 percent slopes; high susceptibility to frost action; high shrink-swell potential; decomposing bedrock at a depth of 3½ to more than 5 feet.
OpB, OpC, OpD, OpE	Poor: excessive gravel	Unsuitable: excessive fines.	Poor: low shear strength; A–7.	0 to 20 percent slopes; decomposing bedrock at a depth of 3½ to more than 5 feet.

See footnotes at end of table.

interpretations—Continued

Soil features affecting—Continued					
Irrigation	Pond reservoir areas	Embankments, dikes, and levees	Terraces and diversions	Grassed waterways	Agricultural drainage
Moderate intake rate; moderately high available water capacity.	Very slow permeability; 0 to 25 percent slopes; seasonal water table at a depth of 1 to 2 feet.	Low shear strength; high compressibility; moderate shrink-swell potential; impervious when compacted.	Very slow permeability; 0 to 25 percent slopes; no hazard to severe erosion hazard.	Moderately high available water capacity; 0 to 25 percent slopes; no hazard to severe erosion hazard.	Very slow permeability; seasonal water table at a depth of 1 to 2 feet.
Moderate intake rate; high available water capacity; 0 to 3 percent slopes.	Slow permeability; 0 to 3 percent slopes; seasonal water table at a depth of 0 to 1 foot.	Low shear strength; slight to medium compressibility; moderate shrink-swell potential; impervious if compacted.	Slow permeability; 0 to 3 percent slopes; little or no erosion hazard.	High available water capacity; 0 to 3 percent slopes; little or no erosion hazard.	Slow permeability; seasonal water table at a depth of 0 to 1 foot.
Moderately rapid intake rate; high available water capacity; 0 to 3 percent slopes.	Moderately rapid permeability; 0 to 3 percent slopes.	Low shear strength; slight compressibility; semipervious if compacted.	Moderately rapid permeability; 0 to 3 percent slopes; no to slight erosion hazard; subject to flooding in places.	High available water capacity; 0 to 3 percent slopes; no to slight erosion hazard; subject to flooding in places.	(2).
Moderate intake rate; high available water capacity; 0 to 3 percent slopes.	Moderately slow permeability; 0 to 3 percent slopes; seasonal water table at a depth of 1 to 2 feet.	Low shear strength; medium compressibility; semipervious if compacted.	Moderately slow permeability; 0 to 3 percent slopes; no to slight erosion hazard; subject to flooding in places.	High available water capacity; 0 to 3 percent slopes; no to slight erosion hazard; subject to flooding in places.	Moderately slow permeability; seasonal water table at a depth of 1 to 2 feet; subject to flooding in places.
Moderate intake rate; high available water capacity; 0 to 50 percent slopes.	Moderately slow permeability; 0 to 50 percent slopes.	Low shear strength; high compressibility; moderate shrink-swell potential; semipervious if compacted.	Moderately slow permeability; 0 to 50 percent slopes; slight to severe erosion hazard.	High available water capacity; 0 to 50 percent slopes; slight to severe erosion hazard.	(2).
Moderate intake rate; high available water capacity; 3 to 15 percent slopes.	Very slow permeability; 3 to 15 percent slopes; seasonal water table at a depth of 2 to 3 feet.	Low shear strength; medium to high compressibility; moderate shrink-swell potential; semipervious to impervious if compacted.	Very slow permeability; 3 to 15 percent slopes; slight to moderate erosion hazard.	High available water capacity; 3 to 15 percent slopes; slight to moderate erosion hazard.	Very slow permeability; seasonal water table at a depth of 2 to 3 feet.
Moderate intake rate; high available water capacity; 2 to 50 percent slopes.	Moderately slow permeability; 2 to 50 percent slopes; decomposing bedrock at a depth of 3½ to 5 feet.	Low shear strength; high compressibility; high shrink-swell potential; impervious if compacted.	Moderately slow permeability; 2 to 50 percent slopes; slight to severe erosion hazard.	High available water capacity; 2 to 50 percent slopes; slight to severe erosion hazard.	(2).
Moderate intake rate; moderate to moderately high available water capacity; 0 to 20 percent slopes; cobblestones thoughout.	Moderately slow permeability; 2 to 50 percent slopes; decomposing bedrock at a depth of 3½ to more than 5 feet.	Low shear strength; high compressibility; moderate shrink-swell potential; impervious if compacted.	Moderately slow permeability; 2 to 50 percent slopes; slight to severe erosion hazard.	High available water capacity; 2 to 50 percent slopes; slight to severe erosion hazard.	(2).

TABLE 6.—*Engineering*

Soil series and map symbols	Suitability as source of—			Soil features affecting—
	Topsoil [1]	Sand and gravel	Road fill	Highway location
OyC	Poor: cobbly	Unsuitable: excessive fines.	Poor: low shear strength; A–7.	0 to 20 percent slopes; decomposing bedrock at a depth of 3½ to more than 5 feet.
Pilchuck: PcB	Poor: sandy material.	Fair for sand if washed. Unsuitable for gravel.	Good: binder needed in places.	0 to 8 percent slopes; subject to flooding in places.
Riverwash: Rh. No interpretations. Material too variable.				
Rock land: Ro. No interpretations. Material too variable.				
Rose Valley: RvB, RvC, RvD	Good	Unsuitable: excessive fines.	Poor: low shear strength; dominantly A–7.	0 to 30 percent slopes; seasonal water table at a depth of 1 to 2 feet; high shrink-swell potential; slip hazard.
RyB	Good	Unsuitable: excessive fines.	Poor: low shear strength; A–7.	0 to 6 percent slopes; seasonal water table at a depth of 0 to 1 foot; high shrink-swell potential; slip hazard.
Sara: SaB, SaC, SaD, ScB	Good for silt loam. Fair for silty clay loam.	Unsuitable: excessive fines.	Poor: low shear strength; A–6 or A–7.	0 to 30 percent slopes; high shrink-swell potential; seasonal water table at a depth of 3 to 4 feet.
Sauvola: SlB, SlC, SlD	Good	Unsuitable: excessive fines.	Fair to poor in uppermost 30 inches; low shear strength; A–4 or A–7. Good below a depth of 30 inches.	0 to 30 percent slopes; high shrink-swell potential; seasonal water table at a depth of 3 to 5 feet.

See footnotes at end of table.

interpretations—Continued

Soil features affecting—Continued					
Irrigation	Pond reservoir areas	Embankments, dikes, and levees	Terraces and diversions	Grassed waterways	Agricultural drainage
Moderate intake rate; moderate to moderately high available water capacity; 0 to 20 percent slopes; cobblestones throughout.	Moderately slow permeability; 0 to 20 percent slopes; decomposing bedrock at a depth of 3½ feet to more than 5 feet.	Low shear strength; medium compressibility; semipervious to impervious if compacted.	Moderately slow permeability; 0 to 20 percent slopes; slight to moderate erosion hazard.	Moderate to moderately high available water capacity; 0 to 20 percent slopes; cobblestones throughout.	(2).
Moderately rapid intake rate; low to moderate available water capacity; 0 to 8 percent slopes.	Very rapid permeability; 0 to 8 percent slopes.	Low to moderate shear strength; slight compressibility; pervious if compacted.	Very rapid permeability; 0 to 8 percent slopes; severe erosion hazard where subject to flooding.	Low to moderate available water capacity; 0 to 8 percent slopes; severe erosion hazard where subject to flooding.	(2).
Moderate intake rate; high available water capacity; 0 to 30 percent slopes.	Very slow permeability; 0 to 30 percent slopes; seasonal water table at a depth of 1 to 2 feet.	Low shear strength; high compressibility; high shrink-swell potential; impervious if compacted.	Very slow permeability; 0 to 30 percent slopes; slight to very severe erosion hazard.	High available water capacity; 0 to 30 percent slopes; slight to very severe erosion hazard.	Very slow permeability; seasonal water table at a depth of 1 to 2 feet.
Moderate intake rate; moderate to moderately high available water capacity; 0 to 6 percent slopes.	Very slow permeability; 0 to 6 percent slopes; seasonal water table at a depth of 0 to 1 foot.	Low shear strength; high compressibility; high shrink-swell potential; impervious if compacted.	Very slow permeability; 0 to 6 percent slopes; none to slight erosion hazard.	Moderate to moderately high available water capacity; 0 to 6 percent slopes; no to slight erosion hazard.	Very slow permeability; seasonal water table at a depth of 0 to 1 foot.
Moderate to moderately slow intake rate; moderately high to high available water capacity; 0 to 30 percent slopes.	Very slow permeability; 0 to 30 percent slopes; seasonal water table at a depth of 3 to 4 feet.	Low shear strength; high compressibility; high shrink-swell potential; impervious if compacted.	Very slow permeability; 0 to 30 percent slopes; slight to severe erosion hazard.	Moderately high to high available water capacity; 0 to 30 percent slopes; slight to severe erosion hazard.	Very slow permeability; seasonal water table at a depth of 3 to 4 feet.
Moderate intake rate; moderately high available water capacity; 0 to 30 percent slopes.	Slow permeability; 0 to 30 percent slopes; seasonal water table at a depth of 3 to 5 feet.	Low shear strength; medium to high compressibility in uppermost 30 inches; slight compressibility at depths below 30 inches; high shrink-swell potential; semipervious to impervious if compacted.	Slow permeability; 0 to 30 percent slopes; slight to severe erosion hazard.	Moderately high available water capacity; 0 to 30 percent slopes; slight to severe erosion hazard.	Slow permeability; seasonal water table at a depth of 3 to 5 feet.

TABLE 6.—*Engineering*

Soil series and map symbols	Suitability as source of—			Soil features affecting—
	Topsoil [1]	Sand and gravel	Road fill	Highway location
Seaquest: SmB, SmC, SmD	Good	Unsuitable: excessive fines.	Poor: low shear strength; A–6.	0 to 30 percent slopes; moderate shrink-swell potential.
Semiahmoo: Sp	Poor: organic soil	Unsuitable: organic soil.	Poor: organic soil	0 to 3 percent slopes; seasonal water table at or near the surface; organic soil.
Sifton: SrB	Poor: excessive gravel.	Fair below a depth of 21 inches; screening and washing required.	Good	0 to 8 percent slopes; subject to flooding in places.
Snohomish: Ss	Fair: silty clay loam.	Unsuitable: excessive fines.	Poor: A–7, Pt	0 to 3 percent slopes; seasonal water table at a depth of 0 to 1 foot; organic material at depths below 15 inches.
Speelyai: SyB, SyE	Poor: gravelly loamy sand.	Fair: screening and washing required.	Good	0 to 60 percent slopes.
Toutle:				
ToB, ToD, TuB, TuD	Good for fine sandy loam. Poor for loamy sand.	Poor: pumice gravel.	Fair: pumice gravel; A–4 or A–1.	0 to 45 percent slopes.
TtB	Poor: gravelly loamy sand.	Poor: pumice gravel.	Fair: pumice gravel; A–2 or A–1.	0 to 8 percent slopes; subject to flooding in places.
Vader: VaD, VaE	Fair: sandstone fragments.	Unsuitable: excessive fines.	Fair: low shear strength; bedrock at a depth of 3½ feet to more than 6 feet.	8 to 50 percent slopes; bedrock at a depth of 3½ feet to more than 6 feet.

[1] Considered in rating is the A horizon or the uppermost 8 inches, whichever is thicker.
[2] Generally not applicable or not needed.

interpretations—Continued

Soil features affecting—Continued					
Irrigation	Pond reservoir areas	Embankments, dikes, and levees	Terraces and diversions	Grassed waterways	Agricultural drainage
Moderate intake rate; high available water capacity; 0 to 30 percent slopes.	Moderately slow permeability; 0 to 30 percent slopes.	Low shear strength; high compressibility; moderate shrink-swell potential; semipervious to impervious if compacted.	Moderately slow permeability; 0 to 30 percent slopes; slight to severe erosion hazard.	High available water capacity; 0 to 30 percent slopes; slight to severe erosion hazard.	(2).
Moderate intake rate; high available water capacity; 0 to 3 percent slopes.	Moderate permeability to a depth of 48 inches, slow at depths below 48 inches; 0 to 3 percent slopes.	(2)	(2)	(2)	Moderate permeability to a depth of 48 inches, slow at depths below 48 inches; seasonal water table at or near the surface.
Moderate intake rate; low available water capacity; 0 to 8 percent slopes.	Very rapid permeability; 0 to 8 percent slopes.	Low shear strength; slight compressibility; pervious if compacted.	Very rapid permeability; 0 to 8 percent slopes; slight to moderate erosion hazard where subject to flooding.	Low available water capacity; 0 to 8 percent slopes.	(2).
Moderately slow intake rate; high available water capacity; 0 to 3 percent slopes.	(2)	(2)	(2)	(2)	Organic material at a depth of 15 inches; seasonal water table at a depth of 0 to 1 foot.
(2)	(2)	(2)	(2)	(2)	(2).
(2)	(2)	(2)	(2)	(2)	(2).
(2)	(2)	(2)	(2)	(2)	(2).
Moderate intake rate; moderately high to high available water capacity; 8 to 50 percent slopes.	Moderately rapid permeability to a depth of 27 inches, rapid permeability at a depth of 27 to 54 inches; 8 to 50 percent slopes; bedrock at a depth of 3½ feet to more than 6 feet.	Embankments: low shear strength; slight to medium compressibility; semipervious to pervious if compacted. Dikes and levees: generally not needed.	(2)	(2)	(2).

In the Unified system (*12*) soils are classified according to their texture and plasticity and the performance as engineering construction material. Soils are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. GP and GW are clean gravels, and GM and GC are gravels that include, respectively, an appreciable amount of nonplastic and plastic fines. SP and SW are clean sands. SM and SC are sands that include fines of silt and clay. ML and CL are silts and clays that have a low liquid limit, and MH and CH are silts and clays that have a high liquid limit. Soils on the borderline between two classes are designated by symbols for both classes; for example, ML–CL.

Soil scientists use the USDA textural classification (*10*). In this, the texture of the soil is determined according to the proportion of soil particles smaller than 2 millimeters in diameter, that is, the proportion of sand, silt and clay. Textural modifiers, such as gravelly, stony, shaly, and cobbly, are used as needed.

Table 5 shows the estimated classification of all the soils in the Area according to all three systems of classification.

Soil properties significant in engineering

Table 5 lists certain properties that form an important base for engineering interpretations. Soils are listed by soil series followed by the mapping symbol.

Values shown in table 5 are based on soil test data (*3*) and standard soil mechanics tests. It is further supported by the experience of local specialists.

Permeability, the rate of water movement through the soil, and the available water capacity are expressed as a range. The available water capacity is the capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. Data on permeability and available water capacity are especially important in making and preparing drainage and soil moisture recommendations. The ranges shown in table 5 are based principally on texture and structure. Mottling, color, root development, and consistence are also important factors.

Reaction is expressed in terms of pH, as taken by field tests.

The shrink-swell potential reflects the volume change expected with changes in moisture content. Problems arise in using soils that have high shrink-swell potential for foundations and for structures to impound water where the water level fluctuates. Soils that have a moderate shrink-swell potential can be used for these purposes in many locations, and shrink-swell features can be improved by using soil modifiers or by other measures. Soils that have low shrink-swell potential are generally good for foundations and many other uses, but some are pervious to water.

Engineering interpretations of soils

Table 6 shows the suitability of each soil in the Area for various purposes. The interpretations are based on the estimates of soil properties in table 5. Observation of field performance, comparison of soil test data from adjacent survey areas, and other reference materials (*3*) support the suitability values. These interpretations are general and will not take the place of examination and evaluation at the site of more complex projects.

The suitability of the soil for topsoil, sand, and gravel is expressed as good, fair, poor, or unsuitable. The volume, the overburden, and the quality are considered. The rating for road fill applies to the depths described. Erodibility, presence of rock, content of organic matter, plasticity of the soil, and its compaction and shear characteristics can lower the rating.

The principal soil features shown in table 6 for each of the engineering practices provide a valuable base for specific interpretations.

Town and Country Planning

This section is for suburban landowners, planners, and developers. Table 7 gives the degree and kind of limitation of the soils of the Cowlitz Area for specified uses. It supplements the soil maps at the back of the survey, which show considerable, but not precise detail, for each small area. For example, not all the small wet areas or all the seasonal seep areas on hillsides are shown on the maps.

The ratings shown in table 7 are based on soil characteristics, particularly permeability, available water capacity, topography, depth, and stability. They do not take into account the inaccessibility of some soils, the distance from population centers, or the development of roads, powerlines, facilities to provide water for domestic use, or other utilities. If the rating given in table 7 is moderate or severe, the main limiting properties are designated. The interpretations are based on observations and on estimates of the conditions that can be expected to restrict various uses. They are based on information obtained from farmers, conservation specialists, suburban landowners, and planners.

Limitation ratings for trails and secondary roads are based on slope, drainage, erodibility, and susceptibility to flooding.

Limitation ratings for golf courses are based on slope and the capacity of the soil to support vegetation and to withstand foot and golf-cart traffic.

Ratings for picnic areas and campsites are based on the capacity of the soil to withstand heavy foot and vehicular traffic and on the ease of movement for these purposes.

Limitation ratings for playgrounds are based upon such soil characteristics as drainage, slope, presence of gravel or cobblestones on the surface, and the capacity of the soil to pack a firm surface and to withstand heavy foot traffic.

The ratings for lawns and ornamentals are based on such soil limitations as drainage, permeability, slope, depth, and texture.

Fertilizer will be needed in nearly all areas and irrigation in many for effective agronomic development. Fertilizer should be applied according to soil tests made after site preparation.

Limitation ratings for septic tank filter fields are based principally on permeability, depth to water table, flood hazard, slope, and depth to bedrock.

Ratings for sewage lagoons are based principally on permeability, depth to bedrock, and slope.

Ratings for foundations for low buildings are based principally on drainage, depth to water table, susceptibility to flooding, slope, shrink-swell potential, and depth to bedrock.

Formation and Classification of the Soils

Soil is the product of soil-forming processes acting on material deposited or accumulated through geologic forces. The important factors in soil formation are parent material, climate, living organisms (particularly vegetation), relief, and time.

Factors of Soil Formation

Climate and living organisms, particularly vegetation, are the active forces in soil formation. Their effect on the parent material is modified by topography and by the length of time the parent material has been in place. The relative importance of each factor differs from place to place. Occasionally one factor dominates and fixes most of the properties of the soil, but normally the interaction of all five factors determines what kind of soil develops in any given place.

Parent material

The soils of the Cowlitz Area developed from two general kinds of parent material. The more extensive is residuum formed in place by the weathering of rocks. The other consists of sand, silt, clay, and rock fragments transported by water, wind, or gravity, or a combination of these forces.

The residual material is derived from several different kinds of rocks. About 45 percent of the area is underlain by basic igneous rocks, including basalt, andesite, breccia, and tuff of the Pliocene, Miocene, Oligocene, and Eocene ages (*4*, *6*, *13*, *14*). The surface in the survey area has been modified by glaciation, pyroclastics, landslides, faulting, folding, and sedimentation. The result, especially in the hills adjacent to the Columbia River, is a complex, irregular pattern of soils. Olympic and Loper soils developed in material weathered from basalt and andesite. Mart soils formed in residuum from andesite, tuff, breccia, and pyroclastic material.

About 10 percent of the Area is underlain by sedimentary rocks of the Eocene age (*4*, *6*). The Olequa soils formed in material weathered from siltstone, sandstone, and shale. Vader soils formed in weathered sandstone. The finer textured Olequa soils lend themselves to faster weathering and genetic horizonation than Vader soils. Illuvial silicate clay has moved into the B horizon of the Olequa soils and has enriched it with clay and coated peds and pores. Moderate structure developed. The coarser textured Vader soils weathered more slowly. Silicate clay did not move into the B horizon; structural development in these soils is weak.

The transported material consists of sediment deposited on flood plains and terraces, valley-fill deposits, glaciofluvial and colluvial deposits, shallow-water deposits of siltstone, sandstone, and clay and silty wind-laid deposits.

About 11 percent of the soils in the Area formed in recent alluvium. They are soils of the Camas, Caples, Clato, Godfrey, Newberg, Pilchuck, Sifton, Snohomish, and Toutle series. There has been little change in the original soil layers of these soils except by mottling and gleying, as a result of somewhat poor drainage.

About 6 percent of the soils in the Area formed in old sediment on terraces. This sediment was deposited in Pleistocene times (*4*). Soils of the Gee, Hillsboro, Kelso, McBee, Minniece, and Speelyai series formed in this material. These soils are older than the recent alluvial soils, but they are still dominated by their parent material. The coarser textured soils are influenced by eluviation processes, and the moderately fine textured soils show the effects of both eluviation and illuviation.

About 20 percent of the soils in the Area formed in wind-laid material, probably of Pleistocene age. Cinebar soils, which occur in the hills and mountains north of the Lewis River in the southeastern part of the Area, and Germany soils, which occur in the hills and mountains north of the Columbia River in the western part of the Area, formed in wind-laid material. These are well drained and show only weak genetic horizonation.

About 5 percent of the soils in the Area formed in tuffaceous siltstone, sandstone, and clay of the Pliocene age. These materials were derived from explosive volcanoes and from erosion of volcanic flows. They were deposited in a broad, shallow basin that contained lakes and swamps over which meandering streams deposited sedimentary debris (*4*). Seaquest and Sara soils formed in these materials. Seaquest soils are moderately fine textured and well drained. Sara soils are fine textured and moderately well drained to somewhat poorly drained.

About 3 percent of the soils of the Area formed in old valley-fill deposits of gravel, sand conglomerate, silt, tuff, and clay. These materials were probably deposited in the lower Pliocene times by an ancestral Columbia River (*6*). The soils that formed in them are the Coweeman, Kalama, Rose Valley, and Sauvola soils. All have been changed to a great extent by genetic processes, but the underlying clay that restricts drainage and the gravel and sand in Kalama soils that give these soils a coarser texture are still important characteristics of the soil profile.

Colluvial deposits of unassorted pumice and andesite occur in the extreme southeastern part of the county and are of minor extent. These are earthflow materials of the Pleistocene and Recent ages. Cispus soils formed in these deposits. They have been influenced very little by genetic processes and are dominated by coarse-textured parent material.

Bogs, which are of Recent age, are of minor importance in the Cowlitz Area. They are the remains of sedges, lilies, and associated water-tolerant plants and include mineral, colloidal, and woody materials (*8*). Semiahmoo soils formed in these materials.

Climate

Differences in climate are directly or indirectly responsible for variations in plant and animal life and for major soil differences. Climate affects the weathering of rocks and the removal and redisposition of material by water, wind, and glaciers. It also determines the percolation rate of water through the soil.

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TABLE 7.—*Degree and kind of soil limitations*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in referring to other series that appear

Soil series and map symbols	Trails and secondary roads	Golf courses	Campsites	Picnic areas
Bear Prairie:				
BpC	Slight	Slight	Moderate: slope	Moderate: slope
BpD	Moderate: slope	Severe: slope	Severe: slope	Severe: slope
BpD2	Moderate: slope	Severe: slope	Severe: slope	Severe: slope
BpE	Severe: slope	Severe: slope	Severe: slope	Severe: slope
Camas: Ca	Slight	Severe: cobbly	Moderate: *flooding* and cobblestones.	Moderate: flooding and cobblestones.
Caples:				
Ce	Moderate: seasonal water table at a depth of 1 to 3 feet.	Slight	Moderate: seasonal water table at a depth of 1 to 3 feet.	Moderate: seasonal water table at a depth of 1 to 3 feet.
Ch	Severe: seasonal water table at a depth of 1 to 3 feet.	Moderate: seasonal water table at a depth of 1 to 3 feet.	Severe: seasonal water table at a depth of 1 to 3 feet.	Severe: seasonal water table at a depth of 1 to 3 feet.
Cinebar:				
CmB	Slight	Moderate: low productivity.	Slight	Slight
CnC	Slight	Severe: slope	Moderate: low productivity.	Moderate: slope
CnD	Moderate: slope	Severe: slope	Severe: slope	Severe: slope
CoB	Slight	Moderate: low productivity.	Slight	Slight
CoC	Slight	Moderate: low productivity.	Moderate: slope	Moderate: slope
CoD	Moderate: slope	Severe: slope	Severe: slope	Severe: slope
CoE	Severe: slope	Severe: slope	Severe: slope	Severe: slope
Cispus:				
CsC	Slight	Moderate: low productivity.	Moderate: slope	Moderate: slope
CsE	Severe: slope	Severe: slope	Severe: slope	Severe: slope
Clato:				
Ct	Slight if not flooded	Slight if not flooded	Slight if not flooded	Slight if not flooded
Cv	Slight if not flooded	Slight if not flooded	Slight if not flooded	Slight if not flooded

See footnotes at end of table.

for town and country planning

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for in the first column of this table]

Playgrounds	Landscaping		Septic tank filter fields	Sewage lagoons [1]	Foundations for low buildings [2]
	Ornamentals	Lawns			
Severe: slope	Moderate: slope	Moderate: slope	Slight if slopes are 3 to 5 percent, moderate if 5 to 10 percent, severe if more than 10 percent.	Moderate if slopes are 3 to 7 percent, severe if more than 7 percent.	Slight if slopes are 3 to 8 percent, moderate if more than 8 percent.
Severe: slope	Moderate: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Severe: slope	Moderate: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Severe: flooding	Moderate	Severe: cobblestones.	Severe: susceptible to flooding.[3]	Severe: very rapid permeability.	Severe: susceptible to flooding.
Severe: seasonal water table at a depth of 1 to 3 feet.	Slight	Slight	Severe: seasonal water table at a depth of 1 to 3 feet.	Slight	Severe: high shrink-swell potential.
Severe: seasonal water table at a depth of 1 to 3 feet.	Slight	Slight	Severe: seasonal water table at a depth of 1 to 3 feet.	Slight	Severe: high shrink-swell potential.
Slight if slopes are 0 to 2 percent, moderate if 2 to 8 percent.	Moderate: low productivity.	Moderate: low productivity.	Slight if slopes are 0 to 5 percent, moderate if 5 to 8 percent.	Moderate: moderate permeability.	Slight.
Severe: slope	Moderate: low productivity.	Moderate: low productivity.	Moderate if slopes are 8 to 10 percent, severe if more than 10 percent.	Severe: slope	Moderate if slopes are 8 to 15 percent, severe if more than 15 percent.
Severe: slope	Moderate: low productivity.	Severe: low productivity.	Severe: slope	Severe: slope	Severe: slope.
Slight if slopes are 0 to 2 percent, moderate if 2 to 8 percent.	Moderate: low productivity.	Moderate: low productivity.	Slight if slopes are 0 to 5 percent, moderate if 5 to 8 percent.	Moderate: moderate permeability.	Slight.
Severe: slope	Moderate: low productivity.	Moderate: low productivity.	Moderate if slopes are 8 to 10 percent, severe if more than 10 percent.	Severe: slope	Moderate if slopes are 8 to 15 percent, severe if more than 15 percent.
Severe: slope	Moderate: low productivity.	Severe: low productivity.	Severe: slope	Severe: slope	Severe: slope.
Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Severe: slope	Moderate: low productivity.	Moderate: low productivity.	Moderate if slopes are 8 to 10 percent, severe if over 10 percent.	Severe: slope	Moderate if slopes are 8 to 15 percent, severe if more than 15 percent.
Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Slight if not flooded.	Slight if not flooded.	Slight if not flooded.	Slight if not subject to flooding, severe if subject to flooding.	Moderate: moderate permeability.	Slight if not subject to flooding, severe if subject to flooding.
Slight if not flooded.	Slight if not flooded.	Slight if not flooded.	Slight if not subject to flooding,[1] severe if subject to flooding.	Severe: very rapid permeability.	Slight if not subject to flooding, severe if subject to flooding.

TABLE 7.—*Degree and kind of soil limitations*

Soil series and map symbols	Trails and secondary roads	Golf courses	Campsites	Picnic areas
Coweeman:				
CwC	Moderate: seasonal water table at a depth of 2 to 3 feet.	Moderate: seasonal water table at a depth of 2 to 3 feet.	Moderate: seasonal water table at a depth of 2 to 3 feet.	Moderate: seasonal water table at a depth of 2 to 3 feet.
CxD	Moderate: seasonal water table at a depth of 1 to 2 feet.	Severe: slope	Severe: slope	Severe: slope
CyB	Severe: seasonal water table at a depth of 0 to 1 foot.	Moderate: seasonal water table at a depth of 0 to 1 foot.	Severe: seasonal water table at a depth of 0 to 1 foot.	Severe: seasonal water table at a depth of 0 to 1 foot.
Gee:				
GeB	Moderate: seasonal water table at a depth of 2 to 4 feet.	Slight	Slight	Slight
GeC	Moderate: seasonal water table at a depth of 2 to 4 feet.	Moderate: seasonal water table at a depth of 2 to 4 feet.	Moderate: slope	Moderate: slope
GeD	Severe: slope	Severe: slope	Severe: slope	Severe: slope
Germany:				
GmB	Slight	Slight	Slight	Slight
GmC	Slight	Moderate: slope	Moderate: slope	Moderate: slope
GmD	Moderate: slope	Severe: slope	Severe: slope	Severe: slope
GmE	Severe: slope	Severe: slope	Severe: slope	Severe: slope
GnD	Moderate: cobblestones and slope.	Severe: slope	Severe: slope	Severe: slope
GnE	Severe: slope	Severe: slope	Severe: slope	Severe: slope
Godfrey:				
Go	Moderate: seasonal water table at a depth of 0 to 2 feet.	Moderate: seasonal water table at a depth of 0 to 2 feet.	Moderate: seasonal water table at a depth of 0 to 2 feet.	Moderate: seasonal water table at a depth of 0 to 2 feet.
Gr	Severe: seasonal water table at a depth of 0 to 2 feet.	Moderate: seasonal water table at a depth of 0 to 2 feet.	Severe: seasonal water table at a depth of 0 to 2 feet.	Severe: seasonal water table at a depth of 0 to 2 feet.
Hillsboro: HlD	Slight	Slight	Slight	Slight
8 to 30 percent slopes	Slight if slopes are 8 to 15 percent, moderate if 15 to 30 percent.	Moderate if slopes are 8 to 20 percent, severe if slopes are 20 to 30 percent.	Moderate if slopes are 8 to 15 percent, severe if more than 15 percent.	Moderate if slopes are 8 to 15 percent, severe if more than 15 percent.
30 to 40 percent slopes	Severe: slope	Severe: slope	Severe: slope	Severe: slope

See footnotes at end of table.

for town and country planning—Continued

Playgrounds	Landscaping		Septic tank filter fields	Sewage lagoons [1]	Foundations for low buildings [2]
	Ornamentals	Lawns			
Severe: slope	Moderate: seasonal water table at a depth of 2 to 3 feet.	Slight	Severe: seasonal water table at a depth of 2 to 3 feet.	Moderate if slopes are 5 to 7 percent, severe if over 7 percent.	Severe: high shrink-swell potential.
Severe: slope	Moderate: slope	Moderate: slope	Severe: seasonal water table at a depth of 1 to 2 feet.	Severe: slope	Severe: high shrink-swell potential.
Severe: seasonal water table at a depth of 0 to 1 foot.	Moderate: permeability.	Moderate: seasonal water table at a depth of 0 to 1 foot.	Severe: seasonal water table at a depth of 0 to 1 foot.	Moderate: MH material.	Severe: high shrink-swell potential.
Slight	Slight	Slight	Severe: seasonal water table at a depth of 2 to 4 feet; very slowly permeable.	Slight if slopes are 0 to 2 percent, moderate if more than 2 percent.	Moderate: moderate shrink-swell potential.
Severe: slope	Slight	Moderate: slope	Severe: seasonal water table at a depth of 2 to 4 feet; very slowly permeable.	Severe: slope	Moderate: slope.
Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Slight if slopes are 0 to 2 percent, moderate if 2 to 6 percent.	Slight	Slight	Slight if slopes are 0 to 5 percent, moderate if 5 to 8 percent.	Moderate: moderate permeability.	Slight.
Severe: slope	Slight	Moderate: slope	Moderate if slopes are 8 to 10 percent, severe if more than 10 percent.	Severe: slope	Moderate if slopes are 8 to 15 percent, severe if more than 15 percent.
Severe: slope	Moderate: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Severe: slope	Moderate: slope	Severe: cobbly and steep.	Severe: slope	Severe: slope	Severe: slope.
Severe: slope	Severe: slope	Severe: cobbly; slope.	Severe: slope	Severe: slope	Severe: slope.
Severe: seasonal water table at a depth of 0 to 2 feet.	Moderate: seasonal water table at a depth of 0 to 2 feet.	Moderate: seasonal water table at a depth of 0 to 2 feet.	Severe: seasonal water table at a depth of 0 to 2 feet.	Slight	Severe: seasonal water table at a depth of 0 to 2 feet.
Severe: seasonal water table at a depth of 0 to 2 feet.	Moderate: seasonal water table at a depth of 0 to 2 feet.	Severe: seasonal water table at a depth of 0 to 2 feet.	Severe: seasonal water table at a depth of 0 to 2 feet.	Slight	Severe: seasonal water table at a depth of 0 to 2 feet.
Moderate: slope	Slight	Slight	Slight if slopes are 0 to 5 percent, moderate if 5 to 8 percent.	Moderate: moderate permeability.	Moderate: moderate shrink-swell potential.
Severe: slope	Moderate: slope	Moderate if slopes are 8 to 20 percent, severe if 20 to 30 percent.	Moderate if slopes are 8 to 10 percent, severe if more than 10 percent.	Severe: slope	Moderate if slopes are 8 to 15 percent, severe if more than 15 percent.
Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.

TABLE 7.—*Degree and kind of soil limitations*

Soil series and map symbols	Trails and secondary roads	Golf courses	Campsites	Picnic areas
Kalama:				
KaB	Slight	Slight	Slight	Slight
KaC	Slight	Moderate: slope	Moderate: slope	Moderate: slope
KaD	Moderate: slope	Severe: slope	Severe: slope	Severe: slope
KaE	Severe: slope	Severe: slope	Severe: slope	Severe: slope
Kelso:				
KeB	Slight	Slight	Slight	Slight
KeC	Moderate: erosion hazard; slope.	Moderate: slope	Moderate: slope	Moderate: slope
KeD	Severe: erosion hazard; slope.	Severe: slope	Severe: slope	Severe: slope
KeE	Severe: erosion hazard.	Severe: slope	Severe: slope	Severe: slope
*Loper:				
LbC For Bear Prairie part of LbC, LbD, LbD2, and LbE, see Bear Prairie series.	Slight	Moderate: slope	Slight if slopes are 3 to 8 percent, moderate if 8 to 15 percent.	Slight if slopes are 0 to 8 percent, moderate if 8 to 15 percent.
LbD	Moderate: slope	Severe: slope	Severe: slope	Severe: slope
LbD2	Moderate: erosion hazard; slope.	Severe: erosion hazard; slope.	Severe: erosion hazard; slope.	Severe: slope; erosion hazard.
LbE	Severe: slope	Severe: slope	Severe: slope	Severe: slope
Made land: Md. Variable material.				
McBee: Mb	Moderate: silty clay surface layer.	Moderate: slow permeability.	Moderate: slow permeability.	Moderate: seasonal water table at a depth of 2 to 5 feet.
Mart:				
MrB	Slight	Slight	Slight	Slight
MrC	Slight	Moderate: slope	Moderate: slope	Moderate: slope
MrD	Moderate: slope	Severe: slope	Severe: slope	Severe: slope
MrE	Severe: slope	Severe: slope	Severe: slope	Severe: slope

See footnotes at end of table.

for town and country planning—Continued

Playgrounds	Landscaping		Septic tank filter fields	Sewage lagoons [1]	Foundations for low buildings [2]
	Ornamentals	Lawns			
Moderate: slope	Slight	Slight	Severe: slow permeability.	Slight if slopes are 0 to 2 percent, moderate if more than 2 percent.	Slight.
Severe: slope	Moderate: slope	Moderate: slope	Severe: slow permeability.	Severe: slope	Moderate: slope.
Severe: slope Severe: slope	Moderate: slope Severe: slope	Severe: slope Severe: slope	Severe: slope Severe: slope	Severe: slope Severe: slope	Severe: slope. Severe: slope.
Moderate: slope	Slight	Slight	Severe: slow permeability.	Slight if slopes are 0 to 2 percent, moderate if more than 2 percent.	Moderate: moderate shrink-swell potential.
Severe: slope	Moderate: slope	Moderate: slope	Severe: slow permeability.	Severe: slope	Moderate: slope.
Severe: slope	Moderate: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Moderate if slopes are 0 to 6 percent, severe if 6 to 15 percent.	Slight if slopes are 3 to 8 percent, moderate if 8 to 15 percent.	Slight if slopes are 3 to 8 percent, moderate if 8 to 15 percent.	Severe: [1] bedrock at a depth of 34 inches.	Severe: bedrock at a depth of 34 inches.	Moderate: bedrock at a depth of 34 inches.
Severe: slope Severe: slope	Moderate: slope Moderate: slope	Severe: slope Severe: erosion hazard; slope.	Severe: slope Severe: bedrock	Severe: slope Severe: slope	Severe: slope. Moderate if slopes are 8 to 15 percent, severe if more than 15 percent.
Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Moderate: slow permeability.	Slight	Slight	Severe: permeability; seasonal water table at a depth of 2 to 5 feet.	Moderate: moderate permeability.	Moderate: moderate shrink-swell potential.
Moderate: slope	Slight	Slight	Severe: moderately slow permeability.	Slight if slopes are 0 to 2 percent, moderate if more than 2 percent.	Moderate: moderate shrink-swell potential.
Severe: slope	Moderate: slope	Moderate: slope	Severe: moderately slow permeability.	Severe: slope	Moderate if slopes are 8 to 15 percent, severe if more than 15 percent.
Severe: slope Severe: slope	Moderate: slope Severe: slope	Severe: slope Severe: slope	Severe: slope Severe: slope	Severe: slope Severe: slope	Severe: slope. Severe: slope.

TABLE 7.—*Degree and kind of soil limitations*

Soil series and map symbols	Trails and secondary roads	Golf courses	Campsites	Picnic areas
Minniece:				
MtB	Moderate: seasonal water table at a depth of 1 to 2 feet.	Moderate: seasonal water table at a depth of 1 to 2 feet.	Moderate: seasonal water table at a depth of 1 to 2 feet.	Moderate: seasonal water table at a depth of 1 to 2 feet.
MtC	Moderate: seasonal water table at a depth of 1 to 2 feet.	Moderate: seasonal water table at a depth of 1 to 2 feet.	Moderate: slope	Moderate: slope
MvA	Moderate: seasonal water table at a depth of 0 to 1 foot.	Severe: seasonal water table at a depth of 0 to 1 foot.	Moderate: seasonal water table at a depth of 0 to 1 foot.	Moderate: seasonal water table at a depth of 0 to 1 foot.
Newberg:				
Ne	Slight	Slight	Slight	Slight
Nw	Moderate: seasonal water table at a depth of 1 to 2 feet.	Moderate: seasonal water table at a depth of 1 to 2 feet.	Moderate: seasonal water table at a depth of 1 to 2 feet.	Moderate: seasonal water table at a depth of 1 to 2 feet.
Olequa:				
OeB	Slight	Slight	Slight	Slight
OeC	Slight	Moderate: slope	Moderate: slope	Moderate: slope
OeD	Moderate: slope	Severe: slope	Severe: slope	Severe: slope
OeE	Severe: slope	Severe: slope	Severe: slope	Severe: slope
OlB	Slight	Slight	Slight	Slight
OlC	Slight	Moderate: slope	Moderate: slope	Moderate: slope
Olympic:				
OmB	Slight	Slight	Slight	Slight
OmC	Slight	Moderate: slope	Moderate: slope	Moderate: slope
OmD	Moderate: slope	Severe: slope	Severe: slope	Severe: slope
OmE	Severe: slope	Severe: slope	Severe: slope	Severe: slope
OpB	Slight	Slight	Slight	Slight
OpC	Slight	Moderate: slope	Moderate: slope	Moderate: slope

See footnotes at end of table.

for town and country planning—Continued

Playgrounds	Landscaping		Septic tank filter fields	Sewage lagoons [1]	Foundations for low buildings [2]
	Ornamentals	Lawns			
Severe: very slow permeability.	Moderate: seasonal water table at a depth of 1 to 2 feet.	Moderate: seasonal water table at a depth 1 to 2 feet.	Severe: very slow permeability.	Slight if slopes are 0 to 2 percent, moderate if more than 2 percent.	Severe: high shrink-swell potential.
Severe: slope	Moderate: slope	Moderate: slope	Severe: very slow permeability.	Severe: slope	Severe: high shrink-swell potential.
Moderate: seasonal water table at a depth of 0 to 1 foot.	Moderate: seasonal water table at a depth of 0 to 1 foot.	Moderate: seasonal water table at a depth of 0 to 1 foot.	Severe: slow permeability.	Slight	Severe: seasonal water table at a depth of 0 to 1 foot.
Slight	Slight	Slight	Slight if not subject to flooding, severe if subject to flooding.	Severe: moderately rapid permeability.	Slight if not subject to flooding, severe if subject to flooding.
Moderate: seasonal water table at a depth of 1 to 2 feet.	Moderate: seasonal water table at a depth of 1 to 2 feet.	Moderate: seasonal water table at a depth of 1 to 2 feet.	Severe: seasonal water table at a depth of 1 to 2 feet; moderately slow permeability; subject to flooding in places.	Slight	Severe: seasonal water table at a depth of 1 to 2 feet.
Slight if slopes are 0 to 2 percent, moderate if 2 to 8 percent.	Slight	Slight	Severe: moderately slow permeability.	Slight if slopes are 0 to 2 percent, moderate if more than 3 percent.	Moderate: moderate shrink-swell potential.
Severe: slope	Moderate: slope	Moderate: slope	Severe: moderately slow permeability.	Severe: slope	Moderate if slopes are 8 to 15 percent, severe if more than 15 percent.
Severe: slope	Moderate: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Moderate: slope; seasonal water table at a depth of 2 to 3 feet.	Slight	Slight	Severe: very slow permeability; water table at a depth of 2 to 3 feet.	Moderate: slope	Moderate: moderate shrink-swell potential.
Severe: slope	Moderate: slope	Moderate: slope	Severe: very slow permeability; water table at a depth of 2 to 3 feet.	Severe: slope	Moderate: slope.
Slight if slopes are 0 to 2 percent, moderate if 2 to 8 percent.	Slight	Slight	Severe: moderately slow permeability.	Moderate: slope	Severe: high shrink-swell potential.
Severe: slope	Moderate: slope	Moderate: slope	Severe: moderately slow permeability.	Moderate: slope	Moderate: moderate shrink-swell potential.
Severe: slope	Moderate: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Severe: slope	Slight	Slight	Severe: moderately slow permeability.	Moderate: slope	Moderate: moderate shrink-swell potential.
Severe: slope	Moderate: slope	Moderate: slope	Severe: moderately slow permeability.	Severe: slope	Moderate if slopes are 8 to 15 percent, severe if more than 15 percent.

TABLE 7.—*Degree and kind of soil limitation*

Soil series and map symbols	Trails and secondary roads	Golf courses	Campsites	Picnic areas
OpD	Moderate: slope	Severe: slope	Severe: slope	Severe: slope
OpE	Severe: slope	Severe: slope	Severe: slope	Severe: slope
OyC	Moderate: cobbly	Severe: cobbly	Moderate: cobbly	Severe: slope
Pilchuck: PcB	Moderate: sandy	Severe: sandy	Moderate: sandy	Slight
Riverwash: Rh. Variable material.				
Rock land: Ro. Variable material.				
Rose Valley:				
RvB	Moderate: seasonal water table at a depth of 1 to 2 feet.	Moderate: seasonal water table at a depth of 1 to 2 feet.	Moderate: seasonal water table at a depth of 1 to 2 feet.	Moderate: seasonal water table at a depth of 1 to 2 feet.
RvC	Moderate: seasonal water table at a depth of 1 to 2 feet.	Moderate: slope	Moderate: seasonal water table at a depth of 1 to 2 feet.	Moderate: slope; seasonal water table at a depth of 1 to 2 feet.
RvD	Severe: slope; erosion hazard.	Severe: slope	Severe: slope	Severe: slope
RyB	Severe: seasonal water table at a depth of 0 to 1 foot.	Severe: seasonal water table at a depth of 0 to 1 foot.	Severe: seasonal water table at a depth of 0 to 1 foot.	Severe: seasonal water table at a depth of 0 to 1 foot.
Sara:				
SaB	Slight	Slight	Slight	Slight
SaC	Slight	Moderate: slope	Moderate: slope	Moderate: slope
SaD	Moderate: slope	Severe: slope	Severe: slope	Severe: slope
ScB	Moderate: seasonal water table at a depth of 3 to 4 feet.	Moderate: seasonal water table at a depth of 3 to 4 feet.	Moderate: seasonal water table at a depth of 3 to 4 feet.	Moderate: seasonal water table at a depth of 3 to 4 feet.
Sauvola:				
SlB	Slight	Slight	Slight	Slight
SlC	Slight	Moderate: slope	Moderate: slope	Moderate: slope
SlD	Moderate: slope	Severe: slope	Severe: slope	Severe: slope

See footnotes at end of table.

for town and country planning—Continued

Playgrounds	Landscaping		Septic tank filter fields	Sewage lagoons [1]	Foundations for low buildings [2]
	Ornamentals	Lawns			
Severe: slope Severe: slope Severe: slope	Moderate: slope Severe: slope Moderate: cobbly	Severe: slope Severe: slope Severe: cobbly	Severe: slope Severe: slope Severe: slope	Severe: slope Severe: slope Severe: coarse fragments; slope.	Severe: slope. Severe: slope. Slight if slopes are 0 to 8 percent, moderate if 8 to 15 percent, severe if more than 15 percent.
Moderate: sandy.	Severe: sandy	Severe: sandy	Slight if not subject to flooding, severe [1] if subject to flooding.	Severe: [1] very rapid permeability.	Slight if not subject to flooding, severe if subject to flooding.
Moderate: seasonal water table at a depth of 1 to 2 feet.	Moderate: seasonal water table at a depth of 1 to 2 feet.	Moderate: seasonal water table at a depth of 1 to 2 feet.	Severe: very slow permeability.	Slight if slopes are 0 to 2 percent, moderate if more than 2 percent.	Severe: high shrink-swell potential.
Severe: slope	Moderate: slope	Moderate: slope	Severe: very slow permeability.	Severe: slope	Severe: high shrink-swell potential.
Severe: slope	Moderate: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Severe: seasonal water table at a depth of 0 to 1 foot.	Severe: seasonal water table at a depth of 0 to 1 foot.	Severe: seasonal water table at a depth of 0 to 1 foot.	Severe: very slow permeability; seasonal water table at a depth of 0 to 1 foot.	Slight if slopes are 0 to 2 percent, moderate if more than 2 percent.	Severe: high shrink-swell potential.
Slight if slopes are 0 to 2 percent, moderate if 2 to 8 percent.	Slight	Slight	Severe: very slow permeability; water table at a depth of 3 to 4 feet.	Slight if slopes are 0 to 2 percent, moderate if more than 2 percent.	Severe: high shrink-swell potential.
Severe: slope	Moderate: slope	Moderate: slope	Severe: very slow permeability; water table at a depth of 3 to 4 feet.	Severe: slope	Severe: high shrink-swell potential.
Severe: slope Moderate: seasonal water table at a depth of 3 to 4 feet.	Moderate: slope Moderate: seasonal water table at a depth of 3 to 4 feet.	Severe: slope Moderate: seasonal water table at a depth of 3 to 4 feet.	Severe: slope Severe: very slow permeability; seasonal water table at a depth of 3 to 4 feet.	Severe: slope Slight if slopes are 0 to 2 percent, moderate if more than 2 percent.	Severe: slope. Severe: high shrink-swell potential.
Slight if slopes are 0 to 2 percent, moderate if 2 to 8 percent.	Slight	Slight	Severe: slow permeability; seasonal water table at a depth of 3 to 5 feet.	Moderate: SM material.	Severe: high shrink-potential.
Severe: slope	Moderate: slope	Moderate: slope	Severe: slow permeability; seasonal water table at a depth of 3 to 5 feet.	Severe: slope	Severe: high shrink-potential.
Severe: slope	Moderate: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.

TABLE 7.—*Degree and kind of soil limitations*

Soil series and map symbols	Trails and secondary roads	Golf courses	Campsites	Picnic areas
Seaquest:				
SmB	Slight	Slight	Slight	Slight
SmC	Slight	Moderate: slope	Moderate: slope	Moderate: slope
SmD	Moderate: slope	Severe: slope	Severe: slope	Severe: slope
Semiahmoo: Sp	Severe: seasonal water table at or near the surface.	Severe: seasonal water table at or near the surface.	Severe: seasonal water table at or near the surface.	Severe: seasonal water table at or near the surface.
Sifton: SrB	Slight if not flooded	Moderate: gravelly surface.	Slight if not flooded	Slight if not flooded
Snohomish: Ss	Moderate: drainage	Moderate: drainage	Moderate: drainage	Moderate: drainage
Speelyai:				
SyB	Moderate: gravelly surface.	Severe: gravelly	Moderate: gravelly surface.	Slight
SyE	Severe: slope	Severe: slope	Severe: slope	Severe: slope
Toutle:				
ToB	Slight if not flooded	Severe: sandy	Slight if not flooded	Slight if not flooded
ToD	Slight if slopes are 8 to 15 percent, moderate if 15 to 30 percent, severe if 30 to 40 percent.	Severe: slope	Moderate if slopes are 8 to 15 percent, severe if 15 to 40 percent.	Moderate if slopes are 8 to 15 percent, severe if 15 to 40 percent.
TtB	Slight if not flooded	Severe: sandy	Slight if not flooded	Slight if not flooded
TuB	Slight	Slight	Slight	Slight
TuD	Moderate if slopes are 15 to 30 percent, severe if 30 to 45 percent.	Severe: slope	Severe: slope	Severe: slope
Vader:				
VaD	Slight if slopes are 8 to 15 percent, moderate if 15 to 30 percent.	Severe: slope	Moderate if slopes are 8 to 15 percent, severe if 15 to 30 percent.	Moderate if slopes are 8 to 15 percent, severe if 15 to 30 percent.
VaE	Severe: slope	Severe: slope	Severe if slopes are 30 to 50 percent.	Severe if slopes are 30 to 50 percent.

[1] It is assumed that protection from flooding is adequate. Depth to seasonal water table is not considered in rating.
[2] Without basements.

for town and country planning—Continued

Playgrounds	Landscaping		Septic tank filter fields	Sewage lagoons [1]	Foundations for low buildings [2]
	Ornamentals	Lawns			
Slight if slopes are 0 to 2 percent, moderate if 2 to 8 percent.	Slight: slope	Slight: slope	Severe: moderately slow permeability.	Slight if slopes are 0 to 2 percent, moderate if more than 2 percent.	Moderate: moderate shrink-swell potential.
Severe: slope	Moderate: slope	Moderate: slope	Severe: moderately slow permeability.	Severe: slope	Moderate if slopes are 8 to 15 percent, severe if more than 15 percent.
Severe: slope	Moderate: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Severe: seasonal water table at or near the surface.	Severe: seasonal water table at or near the surface.	Severe: seasonal water table at or near the surface.	Severe: seasonal water table at or near the surface.	Severe if organic matter is more than 15 percent.	Severe: seasonal water table at or near surface.
Moderate if not flooded.	Moderate if not flooded.	Moderate if not flooded.	Slight if not subject to flooding, severe [1] if subject to flooding.	Severe: [1] very rapid permeability.	Slight if not subject to flooding, severe if subject to flooding.
Moderate: drainage.	Moderate: drainage.	Moderate: drainage.	Severe: seasonal water table at a depth of 0 to 1 foot.	Severe if organic matter is more than 15 percent.	Severe: seasonal water table at a depth of 0 to 1 foot.
Severe: gravelly surface.	Severe: shallow soil.	Severe: shallow soil.	Severe: slow permeability.	Moderate to severe: SP–SM material.	Slight.
Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Slight if slopes are 0 to 2 percent, moderate if 2 to 8 percent.	Severe: droughty	Severe: droughty	Slight if slopes are 0 to 5 percent, moderate [1] if 5 to 8 percent.	Severe: [1] very rapid permeability.	Slight.
Severe: slope	Severe: droughty	Severe: droughty	Moderate if slopes are 8 to 10 percent, severe [1] if more than 10 percent.	Severe: [1] slope	Moderate if slopes are 8 to 15 percent, severe if more than 15 percent.
Moderate: gravel on surface.	Severe: droughty	Severe: droughty	Slight if slopes are 0 to 5 percent, moderate if 5 to 8 percent, severe if subject to flooding.	Severe: [1] very rapid permeability.	Slight if not subject to flooding, severe if subject to flooding.
Slight if slopes are 0 to 2 percent, moderate if 2 to 8 percent.	Severe: droughty	Severe: droughty	Slight if slopes are 0 to 5 percent, moderate [1] if 5 to 8 percent.	Severe: [1] very rapid permeability.	Slight.
Severe: slope	Severe: slope	Severe: slope	Severe: [1] slope	Severe: [1] slope	Severe: slope.
Severe: slope	Moderate: slope	Severe: slope	Moderate to severe: [1] slope; bedrock at a depth of 3½ to more than 6 feet.	Severe: [1] slope	Moderate if slopes are 8 to 15 percent, severe if more than 15 percent.
Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.

[3] Hazard of contamination of ground water.

The Cowlitz Area has a marine-type climate. Summers are cool and dry, and winters are mild, but wet and cloudy. Rainfall is heavier and temperatures are lower at the higher elevations in the mountains than in the valleys. Rains, however, are gentle and moisten the soil much more effectively than torrential downpours. The rainwater soaks into the soil and percolates downward. In regions where humidity is high, such as in the Cowlitz Area, the soils are more highly leached than in semiarid and desert regions. For this reason, most of the bases have been leached out and the soils in the Cowlitz Area are generally acid in reaction.

Climate has a marked effect on the productivity and fertility of soils. Soils, such as the Clato, coarse variant, that have an average annual rainfall of 50 inches are generally more fertile than similar soils, such as Sifton soils, that receive 90 inches or more of annual rainfall. At the higher elevations, the growing season is shorter, spring frost is later, fall frost is earlier, and the average annual temperature is lower than at lower elevations. Soils at higher elevations are less productive than those at lower elevations. The Bear Prairie and Vader soils, for example, progressively yield less timber as elevation increases because the climate is less favorable. At an elevation of 1,200 feet, these soils produce about 760 board feet of Douglas-fir per acre per year. At 2,400 feet, these same soils produce only about 274 board feet per acre per year.

Living organisms

All life on and in the soil affects soil formation. The raw soil material is first invaded by simple forms of life, such as bacteria and fungi, that grow and multiply. Mosses and lichens appear, followed by grasses, shrubs, and trees.

Plant and animal life furnish organic matter and bring plant nutrients from the lower layers to the upper ones. Grasses and trees drop their dead leaves and trunks on the surface of the soil, and these furnish an enormous quantity of organic material over a long period. The roots of these plants permeate the soil sometimes to a depth of many feet and make it more or less porous. The decay of roots, especially those of grasses, provides a large amount of organic matter. The organic material from grass and tree leaves is eaten by worms and is thus mixed with the mineral soil material.

Deep-rooted plants bring water from deeper horizons to the surface and into the stems, trunks, and leaves of the plants. This water brings with it a certain amount of dissolved mineral material. When the leaves fall and the plants themselves decay, these minerals are returned to the surface of the soil. This process, then, brings important nutrients from the deeper horizons and parent material to the surface of the soil and enriches the surface layer.

Soils that formed under grass and bracken, both of which have fibrous, deep-reaching roots, have a very dark brown to black surface layer. Some of the Germany and Bear Prairie soils formed under a partial cover of bracken. Soils that formed under coniferous and deciduous vegetation generally have a very dark grayish-brown to brown surface layer. An example is Kelso soils.

The decay of forest debris causes the formation of organic acids of various kinds, including carbonic acid. These acids in solution hasten the leaching processes of soils and soil material, and basic elements are rapidly leached away. Most forested soils in humid regions are strongly acid, for example, Bear Prairie soils.

An important process in humid regions where there is a great amount of leaching is nutrient circulation. Nutrients released from organic material through decay are leached from the surface and are carried downward by percolating water. Plant roots intercept the downward moving water and carry the water and dissolved nutrients back up to the plants.

The remains of sedges, rushes, moss, labrador-tea, and other plants that tolerate wetness have added to the accumulation of peat in bog areas. Semiahmoo peat formed in this manner.

Animals convert plant remains into soil organic matter. They eat the plants, and the waste is returned to the soil where it is further transformed into organic matter.

Burrowing animals, such as mice, moles, and mountain beaver, mix various horizons of the soils and thus supply a certain amount of fresh parent material to the surface layer, from which plant nutrients have been leached. In places the steep and very steep Olympic soils have been subject to the mixing and churning of the mountain beaver. Earthworms feed on soil organic matter and thoroughly mix soils in which they live. They move and enrich many tons of soil to the acre each year. The burrows of worms and small animals in many places reach deeply into the soil, and the excavated material is spread out over the surface. When the burrows are abandoned, the cavities are filled with surface soil rich in organic material. It is possible for roots to make rapid growth through some of this relatively rich material and to penetrate more deeply into the substratum than would otherwise be possible.

Micro-organisms play an important part in the development of soils. They change raw vegetable material into organic matter. Bacteria and various kinds of fungi decay the dead leaves and other plant remains, which are then incorporated into the soil as organic matter. Microscopic animals live on some of these plant remains and help convert them into soil material.

Relief

The shape of the landscape influences soil formation because it affects drainage, erosion, plant cover, and moisture and air conditions within the soil. Undulations in the surface cause water to drain away from the high spots and collect in the low spots.

Runoff is more rapid on moderate and steep slopes than on gentler slopes, and less water penetrates the soil. In this humid climate, vegetation covers most of the ground surface. It slows down the runoff and permits water to percolate through the soil. The steeper the slope, however, the more runoff. For example, Olympic silt loam, 2 to 8 percent slopes, has slow runoff. Olympic silt loam, 30 to 50 percent slopes, has rapid runoff.

In some places water concentrates on the soil surface or is retained in the soil for a large part of the year. Water drains very slowly or not at all from basins and depressions. In such areas the large amount of moisture encourages the growth of plants that require ample water. These are areas where reeds, sedges, and mosses

have accumulated to form organic soils, such as Semiahmoo peat. Gleyed soils occur in depressions and nearly level areas. An example is Caples soils.

Sloping soils, such as Olympic soils, are likely to be well drained and to have A and B horizons that are brown and reddish brown in color. Nearly level soils are not so well drained and are likely to have grayish colors. An example is Minniece, loamy variant. Generally, there is also more mottling in soils that have low slope gradients.

Time

The length of time required to develop a given kind of soil depends on the climate, the kinds and amounts of living organisms, the type of parent material, and the character of the relief.

In time, a profile develops that has two or more horizons. Young soils have more weakly expressed horizons than old soils. Soils in arid climates develop more slowly than soils in humid climates. Steep soils develop distinct horizons more slowly than nearly level soils.

Generally, the soils of the Cowlitz Area that formed in residuum on hills, such as Olympic soils, or soils formed in old valley-fill deposits, such as Rose Valley soils, are old enough to be at least moderately well developed.

Enough time has elapsed for the Olympic soils to show the effects of clay movement from the A horizon and a buildup of clay in the B horizon. The clay is oriented, and clay films are forming on peds and along pore walls. The soils are old enough that their structure is moderately well expressed, they are well drained, oxidized colors are dominant, and weathering has taken place at depths in excess of 5 feet.

Rose Valley soils are old enough for extensive movement and development of clay to have taken place. Much of the clay has been leached out of the A horizon to the B horizon. In the B horizon, the clay is oriented and clay films have formed on ped surfaces and in pores. The soils are old enough to have developed strong, prismatic and angular blocky structure and to have accumulated manganese dioxide concretions.

Soils that formed in young alluvium on flood plains, such as the Newberg soils, are weakly developed, and the parent material shows little evidence of change. There is only a slight darkening of the A horizon and no evidence of clay movement.

The older soils in this Area are more highly leached of lime and other bases, have lower pH values, and are, in general, less fertile than the younger soils.

The slumping of soils on hills destroys areas of residual soils by burying, shattering, and mixing the material in the slumped block. New surfaces are exposed to weathering. As a result, there are local differences in the age of these soils and in the degree of their development.

Classification of the Soils

Classification consists of an orderly grouping of soils according to a system designed to make it easier to remember soil characteristics and interrelationships. Classification is useful in organizing and applying the results of experience and research. Soils are placed in narrow classes for discussion in detailed soil surveys and for application of knowledge within farms and fields. The many thousands of narrow classes are then grouped into progressively fewer and broader classes in successively higher categories, so that information can be applied to large geographic areas.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (*2*) and revised later (*9*). The system currently used by the National Cooperative Soil Survey was developed in the early sixties (*7*) and adopted in 1965 (*11*). It is under continual study.

The current system of classification has six categories. Beginning with the most inclusive, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. The criteria for classification are soil properties that are observable or measurable, but the properties are selected so that soils of similar genesis are grouped together. The placement of some soil series in the current system of classification, particularly in families, may change as more precise information becomes available.

Table 8 shows the classification of each soil series of the survey area by family, subgroup, and order, according to the current system.

Following are brief descriptions of each of the categories in the current system.

Order.—Ten soil orders are recognized in the current system. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate the soil orders are those that tend to give broad climatic groupings of soils. Two exceptions are Entisols and Histosols, which occur in many different climates.

The six orders to which the soils in the Cowlitz Area belong are Alfisols, Entisols, Histosols, Inceptisols, Mollisols, and Ultisols.

Alfisols have a light-colored surface layer, a clay-enriched B horizon, an accumulation of aluminum and iron, and a base saturation of more than 35 percent.

Entisols are mineral soils that formed either in recent alluvium or in older material consisting of almost pure quartz sand. They have little, if any, horizon development.

Histosols are soils that formed from organic material.

Inceptisols are mineral soils that formed in young, but not recent, material. They lack well-defined horizons. Generally, they have a slight accumulation of organic matter in the surface layer and weak subangular blocky structure in the B2 horizon.

Ultisols are mineral soils that have a horizon of clay accumulation and base saturation lower than 35 percent.

Mollisols are mineral soils that have a thick, dark-colored surface layer that has high base saturation.

Suborder.—Each order is divided into suborders, primarily on the basis of soil characteristics that produce classes having genetic similarity. A suborder has a narrower climatic range than an order. The criteria for suborders reflect either the presence or absence of water-logging or differences in climate or vegetation.

Great Group.—Each suborder is divided into great groups on the basis of uniformity in the kind and sequence of genetic horizons.

Subgroup.—Each great group is divided into sub-

TABLE 8.—*Soil series classified according to the current system of classification*

Series	Family	Subgroup	Order
Bear Prairie [1]	Medial, mesic	Typic Dystrandepts	Inceptisols.
Camas	Sandy-skeletal, mixed, nonacid, mesic	Fluventic Haploxerolls	Mollisols.
Caples	Fine, mixed, nonacid, mesic	Mollic Fluvaquents	Entisols.
Cinebar	Medial, mesic	Umbric Vitrandepts	Inceptisols.
Cispus	Cindery, mesic	Umbric Vitrandepts	Inceptisols.
Clato	Coarse-silty, mixed, mesic	Dystric Fluventic Xerochrepts	Inceptisols.
Clato, coarse variant	Coarse-loamy, mixed, nonacid, mesic	Typic Xerofluvents	Entisols.
Coweeman	Clayey, mixed, mesic	Typic Ochraquults	Ultisols.
Coweeman, dark variant.	Very fine, montmorillonitic, mesic	Aeric Vertic Ochraqualfs	Alfisols.
Gee	Fine-silty, mixed, mesic	Typic Glossudalfs	Alfisols.
Germany	Coarse-silty, mixed, mesic	Pachic Xerumbrepts	Inceptisols.
Godfrey	Fine, mixed, nonacid, mesic	Typic Fluvaquents	Entisols.
Hillsboro	Fine-silty, mixed, mesic	Ultic Argixerolls	Mollisols.
Kalama	Fine-loamy, mixed, mesic	Ultic Haploxeralfs	Alfisols.
Kelso	Fine-silty, mixed, mesic	Mollic Haploxeralfs	Alfisols.
Loper	Coarse-loamy, mixed, mesic	Dystric Xerochrepts	Inceptisols.
McBee [2]	Fine-silty, mixed, mesic	Cumulic Ultic Haploxerolls	Mollisols.
Mart	Fine-silty, mixed, mesic	Typic Xerumbrepts	Inceptisols.
Minniece	Fine, mixed, mesic	Typic Umbraqualfs	Alfisols.
Minniece, loamy variant.	Fine-loamy, mixed, mesic	Typic Ochraqualfs	Alfisols.
Newberg [3]	Coarse-loamy, mixed, mesic	Fluventic Haploxerolls	Mollisols.
Newberg, silty variant	Coarse-silty, mixed, mesic	Fluventic Haploxerolls	Mollisols.
Olequa	Fine-silty, mixed, mesic	Ultic Haploxeralfs	Alfisols.
Olequa, moderately well drained variant.	Fine-silty, mixed, mesic	Ultic Haploxeralfs	Alfisols.
Olympic	Clayey, mixed, mesic	Xeric Haplohumults	Ultisols.
Pilchuck	Mixed, mesic	Typic Xeropsamments	Entisols.
Rose Valley	Fine, mixed, mesic	Argiaquic Xeric Argialbolls	Mollisols.
Rose Valley, thin surface variant.	Fine, mixed, mesic	Typic Glossaqualfs	Alfisols.
Sara	Fine, mixed, mesic	Mollic Glossudalfs	Alfisols.
Sauvola	Clayey, mixed, mesic	Xeric Haplohumults	Ultisols.
Seaquest	Fine-loamy, mixed, mesic	Xeric Haplohumults	Ultisols.
Semiahmoo	Euic, mesic	Typic Medisaprists	Histosols.
Sifton	Medial over sandy skeletal, mixed, mesic	Umbric Vitrandepts	Inceptisols.
Snohomish	Fine, mixed, nonacid, mesic	Thapto-Histic Fluvaquents	Entisols.
Speelyai	Sandy-skeletal, mixed, mesic	Typic Udorthents	Entisols.
Toutle	Medial, mesic	Typic Vitrandepts	Inceptisols.
Vader	Coarse-loamy over sandy or sandy-skeletal, mixed, mesic.	Dystric Xerochrepts	Inceptisols.

[1] The Bear Prairie soils in the Cowlitz Area are taxadjuncts to the Bear Prairie series. They have a thinner A horizon than is appropriate to the classification shown.

[2] The McBee soils in the Cowlitz Area are taxadjuncts to the McBee series. They have a thicker A horizon and a more acid B horizon than is appropriate to the classification shown.

[3] The Newburg soils in the Cowlitz Area are taxadjuncts to the Newberg series. They have a thicker A horizon than is appropriate to the classification shown.

groups, one representing the central (typic) segment of the group, and others, called intergrades, made up of soils that have mostly properties of one great group but also one or more properties of another great group.

Family.—Families are established within each subgroup, primarily on the basis of properties important to plant growth. Some of these properties are texture, mineralogy, reaction, soil temperature, permeability, consistence, and thickness of horizons.

Series.—The series has the narrowest range of characteristics of the categories in the classification system. It is explained in the section "How This Survey Was Made."

A detailed description of each soil series in the survey area is given in the section "Descriptions of the Soils."

General Nature of the Area

Pioneers of the 1840's, traveling between Vancouver and Puget Sound, were attracted by the rich bottom lands along the Cowlitz River and settled in the vicinity of what is now Kelso and Longview. The Hudson's Bay Company built warehouses on the site of Longview to store hides, furs, wool, and wheat. The first settlers were farmers, trappers, and merchants. In the 1880's, the first large lumber mills tapped the rich timber resources.

Longview, the first planned city in the northwest and the largest city in the Cowlitz Area, has a population of 25,475. In 1960, Kelso, the county seat, had a population of 8,900; Woodland, 1,520; Castle Rock, 1,420; and Kalama, 1,140.

Logging and the manufacturing of timber products are the chief industries in the Area. Other products and industries include chemicals, boats, iron, steel and stainless steel, machine shops, an aluminum reduction plant, steel and sheet metal fabricators, concrete products, food products, machinery, paint and varnish, and flying automobiles. There are 146 manufacturing establishments, and 12 that employ 100 or more employees.

The Cowlitz Area is served by transcontinental railroads. A railway company connects the logging operations to the Longview millsite and Longview Junction. as well as with the main railroad line at Rocky Point Junction north of Kelso. Overnight motor freight service is available to all Pacific Northwest markets.

There is a municipal airport at Kelso and an international airport less than an hour's drive from Kelso and Longview.

The Area is served by two transcontinental buslines. Daily round-trip bus service is provided between Kelso and the ocean beaches, and local buses provide service within Kelso and Longview.

The port of Longview is located on the Columbia River approximately 50 miles east of the Pacific Ocean. It operates a versatile integrated marine terminal that handles bulk, liquid, and dry cargo. The port is served by steamship lines to the Atlantic Coast, the Caribbean, Europe, South Africa, the Philippine Islands, and the Orient. These lines have frequent, regular sailings to and from Longview.

The port of Kalama has a small but expanding dock area and a small boat harbor. The port of Woodland is acquiring and preparing land for industrial development.

The Cowlitz Area is served with natural gas from the San Juan Basin in New Mexico and the Alberta fields in Canada by a transmission line capable of delivering over 600 million cubic feet of gas per day.

The Area is also served with electricity. In addition, the county owns and operates a steam plant, owns an hydroelectric plant, and has contracted for additional energy from the output of Priest Rapids Dam and Wanapum Dam on the Columbia River.

Recreational Facilities

Recreational facilities in the Cowlitz Area include parks and playgrounds, swimming pools, night-lighted athletic fields, private golf courses, bowling alleys, tennis courts, theaters, a roller skating rink, and fairgrounds.

There are many camping and picnic areas in the survey area, as well as excellent fishing streams and lakes. The Columbia, Cowlitz, Kalama, and Troutle Rivers attract many people who fish for silver and Chinook salmon, steelhead, sea-run cutthroat trout, and sturgeon. Silver Lake is rated high for bass and other spiny ray fish, and the higher lakes and Lake Merwin, Yale Reservoir, and Swift Reservoir in adjoining Skamania County provide boating, water skiing, and trout fishing. There is also an annual run of smelt in the Cowlitz River.

The Area provides excellent hunting for bear, deer, elk, grouse, pheasant, and ducks.

Farming [5]

According to the 1964 U.S. Census of Agriculture, the number of farms in Cowlitz County decreased from 1,014 in 1959 to 867 in 1964. Other statistics were as follows:

	Acres in 1959	*Acres in 1964*
Land in farms	80, 176	83, 749
Average size of farms	79	97
Cropland harvested	12, 369	10, 455
Cropland used only for pasture	10, 778	12, 773
Cropland not harvested and not pastured	1, 805	1, 729
Cultivated summer fallow	575	127
Woodland used for pasture	24, 043	21, 046
Woodland not used for pasture	19, 372	20, 956
Other pasture (not cropland or woodland)	7, 181	13, 434
Irrigated land in farms	2, 507	2, 544

Many of the farms are small. About 16 percent of the farms are less than 10 acres, and only about 15 percent are more than 140 acres. About 86 percent of the farms are operated by owners. The rest are operated by part-owners, managers, and tenants.

Tables 9 and 10 show the acreage of the principal crops and the number of fruit and nut trees and grapevines grown in Cowlitz County. The crops grown most extensively are hay and forage crops. Some small grain is cut for hay or for silage. Grass-legume mixtures are grown for pasture, hay, and silage. Field corn is used for silage; sweet corn, truck crops, strawberries, and cane fruit are grown for the fresh market and canneries. Bulbs and peppermint are specialty crops grown on the bottom land of the Columbia River.

Most of the income from the sale of farm products in 1964 was derived from the sale of livestock and livestock products.

TABLE 9.—*Acreage of principal crops in stated years*

Crop	1959	1964
	Acres	*Acres*
Corn cut for silage	419	433
Oats harvested	303	97
Land from which hay was cut	10, 384	7, 926
Alfalfa and alfalfa mixtures cut for hay	124	178
Clover, timothy, and mixtures of clover and grasses cut for hay	5, 081	5, 655
Vetch or peas, alone or mixed with oats or other grains, cut for hay	47	44
Oats, wheat, barley, rye, or other small grains cut for hay	514	401
Wild hay cut	1, 534	774
Other hay cut	1, 662	403
Grass silage made from cut grasses, alfalfa, clover, or small grains	1, 518	471
Mint harvested for oil	578	755
Sweet corn	163	238
Cucumbers and pickles	42	76
Cabbage	31	(1)
Carrots	130	(1)
Strawberries	101	63

[1] No data available.

[5] Statistics in this section apply to all of Cowlitz County.

TABLE 10.—*Number of fruit and nut trees and grapevines in stated years*

Tree or vine	1959	1964
	Number	*Number*
Apples	2,663	1,051
Peaches	207	26
Bartlett pears	812	261
Pears other than Bartlett	251	130
Grapes	336	162
Plums and prunes	872	341
Sour cherries	130	62
Sweet cherries	612	302
English walnuts	491	662
Filberts	5,880	3,774

TABLE 11.—*Number of livestock and poultry on farms in stated years*

Livestock and poultry	1959	1964
Cattle and calves	15,092	15,312
Milk cows	3,862	2,480
Horses	561	(1)
Hogs and pigs	1,510	497
Sheep and lambs	1,755	944
Chickens, 4 months old and over	77,990	62,221
Chickens, including broilers sold	319,135	370,200

[1] Not recorded.

Table 11 shows the number of livestock and poultry on farms in stated years.

The number of horses used on farms has greatly decreased in the last few decades, but an increasing number of horses are used for riding and recreation. The numbers of hogs and cattle vary with fluctuations in price and demand.

Climate [6]

Climate of the Cowlitz Area is predominantly a mid-latitude, west coast marine-type with moist air, cool dry summers, mild but rather wet and cloudy winters, and a small daily range in temperature. There is a decided difference between the climate at the higher elevations of the eastern and western sections of the Area and that in the lower valleys. The Cascade Mountains shield this area from the higher summer and lower winter temperatures in eastern Washington, and the Willapa Hills offer some protection from winter storms that move inland from the ocean. Cold air in winter and hot air typical of summer, flowing westward through the Columbia River Gorge, have some influence on the climate.

One of the major climate controls is the position and intensity of the large high and low pressure centers in the north Pacific Ocean. A circulation of air around these two regions brings a prevailing flow of air from a westerly or northwesterly direction into this area in

[6] By EARL L. PHILLIPS, climatologist for Washington, National Weather Service, U.S. Department of Commerce.

TABLE 12.—*Temperature*

[Data from Longview,

Month	Temperature [1]				Precipitation [2]		
	Average daily maximum	Average daily minimum	2 years in 10 will have at least 4 days with—		Average total	1 year in 10 will have—	
			Maximum temperature equal to or higher than—	Minimum temperature equal to or lower than—		Less than—	More than—
	°F.	°F.	°F.	°F.	*In.*	*In.*	*In.*
January	44.5	31.8	55	17	5.81	2.4	9.2
February	49.2	33.1	60	23	4.87	2.5	8.4
March	54.1	35.1	66	27	4.85	2.3	7.1
April	61.4	38.6	74	32	2.72	.6	5.2
May	67.7	42.9	82	34	2.30	.9	4.5
June	71.8	47.5	85	38	2.14	.2	3.9
July	77.8	50.4	90	42	.75	(3)	1.9
August	77.3	50.7	89	43	1.26	.3	2.8
September	73.1	48.2	88	39	2.01	.3	4.0
October	63.2	43.0	75	31	4.40	1.8	7.3
November	52.3	36.6	61	24	6.43	1.7	10.8
December	46.9	34.5	55	22	7.56	3.9	10.8
Annual	61.6	41.0			45.10	29.7	58.0

[1] The highest temperature on record is 105° F.; the lowest is 1° F.

[2] The annual precipitation was 59.16 for the wettest year on record and 28.41 for the driest year. The heaviest monthly precipitation was 20.13 inches. The heaviest 24-hour rainfall was 2.9 inches.

[3] Trace.

summer, and from a southwesterly direction in winter. This circulation of air results in a rainy season beginning in fall, reaching a peak in winter, then decreasing in spring, to a dry season in summer. The number of days that have measureable rainfall each month increases from less than 5 in midsummer to 20 or more late in fall and in winter. Precipitation decreases along the eastern slopes of the Willapa Hills and increases along the western slopes of the Cascade Mountains. The average annual precipitation in the lower valleys between these ridges ranges from 45 to 60 inches. It increases to between 80 and 100 inches or more along the western slope of the Cascades. The heaviest precipitation at the lower elevations probably occurs along the Lewis River and other small east-west valleys in the foothills of the Cascades. Along the Lewis River, where the Cispus and Cinebar soils occur, the annual precipitation ranges from 75 to 120 inches. Temperature and precipitation data, compiled from records of the U.S. Weather Bureau, are given in tables 12, 13, and 14.

Snowfall is light in the lower valleys, which make up most of the survey area. It increases in the higher areas in the eastern and western sections. The snowline in midwinter extends down to between 1,000 and 2,000 feet in elevation. Along the western slopes of the Cascades and below an elevation of 3,000 feet, the winter season snowfall ranges from 100 to 300 inches and reaches a depth of 3 to 8 feet; while at an elevation above 5,000 feet, the snowfall ranges from 400 to 600 inches and accumulates to a depth of 10 to 20 feet. A few times each winter the daily snowfall ranges from 18 to 24 inches. At the higher elevations, snow can be expected in the latter half of October and a snow cover usually remains on the ground from the last half of November until June.

The most serious flooding occurs along rivers with headwaters in the higher elevations of the Cascades, generally between mid-October and mid-January. During this period, snow reaches a depth of 1 to 6 feet on the higher slopes. As storms move inland from the Pacific, the freezing line frequently rises above the summit of the mountains, and 2 to 6 inches of rainfall in 24 hours can cause rivers to rise rapidly and flood in the lower valleys. Waters in the Columbia River usually reach their highest level in May or June.

In winter, the average maximum and minimum temperatures decrease about 3° F. for each 1,000 feet of increase in elevation. In summer, the decrease is slightly less at elevations below 3,000 feet. The average highest and lowest relative humidity each day ranges from 75 to 90 percent in winter, 55 to 90 percent in spring and fall, and 45 to 86 percent in summer. During brief periods of dry, easterly winds the relative humidity may range from 20 to 30 percent. The highest temperatures in summer and the lowest in winter usually occur with easterly winds. The highest winds are generally from the south or southwest. Wind velocities ranging from 40 to 50 m.p.h. can be expected each year. A statistical analysis of extreme wind velocities at 30 feet above the surface indicates that the extreme velocity of wind to expect once each 2 years is 50 to 55 m.p.h. Once each 50 years it is 60 to 80 m.p.h., and once each 100 years

and precipitation

elevation 12 feet]

Precipitation [2]—Continued									
2 years in 10 will have—		3 years in 10 will have—		4 years in 10 will have—		Average snowfall	Maximum depth of snow on ground	Average number of days with snow cover	Average depth of snow on days with snow cover
Less than—	More than—	Less than—	More than—	Less than—	More than—				
In.	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*		*In.*
3.5	8.4	3.7	8.3	4.5	6.1	4.7	20	5	3
3.1	6.6	3.7	5.3	4.0	5.2	1.4	11	2	2
3.2	6.2	3.9	6.0	4.6	5.5	.8	(3)	1	(3)
1.2	4.0	1.7	3.5	2.5	2.9	----------	----------	----------	----------
1.1	3.6	1.3	3.0	1.7	2.6	----------	----------	0	----------
.5	3.5	1.2	3.2	1.8	2.4	----------	----------	0	----------
.1	1.4	.2	1.0	.3	.9	----------	----------	0	----------
.4	2.4	.5	1.9	.5	1.4	----------	----------	0	----------
.8	2.9	1.3	2.8	1.6	2.2	----------	----------	0	----------
2.8	6.7	3.2	4.9	3.4	4.5	(3)	----------	0	----------
2.5	9.6	4.2	9.4	6.0	7.7	(3)	3	1	(3)
4.3	10.4	5.6	8.9	6.5	8.3	.3	1	1	(3)
35.8	55.4	41.3	50.6	43.2	46.7	7.2	----------	----------	----------

TABLE 13.—*Average monthly and annual precipitation at six stations*

Station	Elevation	Period	January	February	March	April	May	June	July	August	September	October	November	December	Annual
	Ft.		*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
Ariel Dam	48	1936–60	9. 38	8. 43	7. 62	4. 37	3. 12	2. 82	0. 93	1. 39	2. 86	6. 87	10. 28	11. 76	69. 83
Castle Rock	43	1954–61	7. 64	7. 24	7. 58	4. 13	2. 47	1. 65	0. 76	1. 32	1. 99	5. 64	9. 15	8. 84	58. 41
Kalama	900	1931–60	9. 08	6. 99	7. 58	4. 35	3. 25	2. 73	0. 93	1. 51	2. 54	5. 94	8. 59	10. 48	63. 97
Kid Valley	690	1941–60	7. 29	6. 30	6. 38	4. 73	3. 47	3. 05	1. 07	1. 82	2. 64	5. 77	8. 02	8. 72	59. 26
Longview	12	1931–60	5. 81	4. 87	4. 85	2. 72	2. 30	2. 14	0. 75	1. 26	2. 01	4. 40	6. 43	7. 56	45. 10
Peterson's Ranch (3 miles east of Cougar)	596	1931–54	17. 88	14. 76	13. 80	7. 38	4. 66	4. 09	1. 38	1. 51	4. 10	11. 17	17. 29	21. 75	119. 77

TABLE 14.—*Probability of freezing temperatures in spring and fall*

Station and temperature	Probability in spring					Probability in fall					Growing season
	90 percent	75 percent	50 percent	25 percent	10 percent	10 percent	25 percent	50 percent	75 percent	90 percent	
											Days
Kid Valley:											
32°F.	Apr. 9	Apr. 21	May 4	May 18	May 30	Sept. 29	Oct. 10	Oct. 22	Nov. 3	Nov. 14	171
28°F	Mar. 4	Mar. 15	Mar. 29	Apr. 12	Apr. 24	Oct. 15	Oct. 26	Nov. 7	Nov. 19	Nov. 30	223
24°F.	Feb. 4	Feb. 16	Mar. 1	Mar. 14	Mar. 27	Nov. 4	Nov. 15	Nov. 30	Dec. 21	----------	274
Longview:											
32°F.	Apr. 5	Apr. 15	Apr. 29	May 13	May 25	Sept. 25	Oct. 6	Oct. 18	Oct. 31	Nov. 10	172
28°F.	Mar. 3	Mar. 16	Mar. 29	Apr. 11	Apr. 24	Oct. 14	Oct. 25	Nov. 6	Nov. 19	Nov. 29	222
24°F.	----------	Feb. 3	Feb. 20	Mar. 7	Mar. 17	Nov. 12	Nov. 23	Dec. 9	----------	----------	292

it is 80 to 90 m.p.h. Wind velocities in excess of these values can be expected on the higher slopes and exposed peaks.

The number of clear or only partly cloudy days ranges from less than 10 per month in winter to 15 in spring and fall and to more than 20 in midsummer. Late in summer and in fall, low clouds and fog frequently fill the lower valleys to a height of 1,500 to 2,500 feet at night; they disappear before midafternoon. Heavy fog can be expected on 3 to 5 days each month in summer and 10 to 14 days late in fall and winter. The sunshine received each month in this area of the State ranges from 20 to 30 percent of the possible sunshine in winter, 35 to 50 percent in spring and fall, and 55 to 65 in summer. The number of hours of possible sunshine on a clear day increases from 8 in December to 16 in June.

Literature Cited

(1) AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS.
1961. STANDARD SPECIFICATIONS FOR HIGHWAY MATERIALS AND METHODS OF SAMPLING AND TESTING. Ed. 8. 2 v., illus.

(2) BALDWIN, MARK, KELLOGG, CHARLES E., and THORP, JAMES.
1938. SOIL CLASSIFICATION. U.S. Dept. Agr. Ybk., pp. 970–1001, illus.

(3) COWLITZ REGIONAL PLANNING COMMISSION.
1963. A COMPREHENSIVE PLAN FOR THE KELSO-LONGVIEW URBAN AREA.

(4) HENDRICKSON, D. A.
1956. EOCENE STRATIGRAPHY OF THE LOWER COWLITZ RIVER-EASTERN WILLAPA HILLS AREAS, SOUTHWESTERN WASHINGTON. Bul. No. 43, Division of Mines and Geology, Washington State Department of Conservation and Development.

(5) MCARDLE, RICHARD E., MEYER, W. H., and BRUCE, D.
1949. THE YIELD OF DOUGLAS FIR IN THE PACIFIC NORTHWEST. U.S. Dept. Agr. Tech. Bul. 201, 64 pp., illus.

(6) SCHLOTS, F. E., and CADY, J. G.
1958. MORPHOLOGY AND GENESIS OF GEE AND KELSO SOILS OF SOUTHWEST WASHINGTON. Presented, Soil Science Society of America, LaFayette, Indiana, August, 1958.

(7) SIMONSON, ROY W.
1962. SOIL CLASSIFICATION IN THE UNITED STATES. Sci. 137: 1027–1034, illus.

(8) TAVERNIER, R., and SMITH, GUY D.
1957. THE CONCEPT OF BRAUNERDE (BROWN FOREST SOIL) IN EUROPE AND THE UNITED STATES.

(9) THORP, JAMES, and SMITH, GUY D.
1949. HIGHER CATEGORIES OF SOIL CLASSIFICATION: ORDER SUBORDER, AND GREAT SOIL GROUPS. Soil Sci. 67: 117–126.

(10) _____
1951. SOIL SURVEY MANUAL. U.S. Dept. Agr. Handbook 18, 503 pp. illus.

(11) _____
1960. SOIL CLASSIFICATION, A COMPREHENSIVE SYSTEM, 7TH APPROXIMATION. 265 pp., illus. [Supplements issued in March 1967 and in September 1968]

(12) UNITED STATES DEPARTMENT OF DEFENSE.
1968. UNIFIED SOIL CLASSIFICATION SYSTEM FOR ROADS, AIRFIELDS, EMBANKMENTS AND FOUNDATIONS. MIL–STD–619B, 30 pp., illus.

(13) WASHINGTON STATE UNIVERSITY.
1963. STATE OF WASHINGTON ENGINEERING SOILS MANUAL. Bul. 275, Soils of Lewis County.

(14) _____
1964. STATE OF WASHINGTON ENGINEERING SOILS MANUAL. Bul. 286, Soils of Clark County.

Glossary

Acidity. See Reaction, soil.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates such as crumbs, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Bedding. Plowing, grading, or otherwise elevating the surface of flat fields into a series of broad beds or "lands" so as to leave shallow surface drains between the beds.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Claypan. A compact, slowly permeable soil horizon that contains more clay than the horizon above and below it. A claypan is commonly hard when dry and plastic or stiff when wet.

Cobblestones. Rounded, or partly rounded fragments of rock, 3 to 10 inches in diameter.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the bases of steep slopes.

Complex, soil. A mapping unit consisting of different kinds of soils that occur in such small individual areas or in such an intricate pattern that they cannot be shown separately on a publishable soil map.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Cemented.—Hard and brittle; little affected by moistening.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger and can be pressed together into a lump.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Loose. Noncoherent when dry or moist; does not hold together in a mass.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Sticky. When wet, adheres to other material and tends to stretch somewhat and pull apart, rather than pull free from other material.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and in Podzolic soils commonly have mottlings below 6 to 16 inches, in the lower A horizon and in the B and C horizons.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors, such as light, moisture, temperature and the physical condition of the soil, are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitational, or free, water has been allowed to drain away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Flood plain. Nearly level land, consisting of stream sediment, that borders a stream and is subject to flooding unless protected artificially.

Genesis, soil. The manner in which a soil originates. Refers especially to the processes initiated by climate and organisms that are responsible for the development of the solum, or true soil, from the unconsolidated parent material, as conditioned by relief and age of landform.

Glacial outwash (geology). Coarse-bedded gravel, sand, and silt deposited by melt water as it flowed from glacial ice.

Granule. A single mass or cluster of many individual soil particles.

Gravel. Rounded or angular rock fragments greater than 2 millimeters but less than 3 inches in diameter.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Inclusions. Areas of soil that are too small to be shown separately on a map of the scale used and are, therefore, mapped with a soil of a different kind.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. It may be limited either by the infiltration capacity of the soil or by the rate at which water is applied to the surface soil.

Lacustrine deposits (geology). Material deposited in lake water and exposed by lowering of the water level or elevation of the land.

Leaching. The removal of soluble materials from soils or other material by percolating water.

Loess. A fine-grained eolian deposit consisting dominantly of silt-sized particles.

Mapping unit. Any soil, miscellaneous land type, soil complex, or undifferentiated soil group shown on the detailed soil map and identified by a symbol.

Massive. See Structure, soil.

Mineral soil. Soil composed mainly of inorganic (mineral) material and low in content of organic material. Its bulk density is greater than that of organic soil.

Morphology, soil. The physical constitution of the soil, including the texture, structure, porosity, consistence, color, and other physical and chemical mineralogical and biological properties of various horizons, and their thickness and arrangement in the soil profile.

Miscellaneous land type. A mapping unit for areas of land that

have little or no natural soil or that are too nearly inaccessible for orderly examination; or that occur where, for other reasons, it is not feasible to classify the soil.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few, common,* and *many;* size—*fine, medium, and coarse;* and contrast—*faint, distinct, and prominent.* The size measurements are these; *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Nutrient plant. Any element taken in by a plant, essential to its growth, and used by it in the production of food and tissue. Nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, zinc, and perhaps other elements obtained from the soil and carbon, hydrogen, and oxygen obtained largely from the air and water, are plant nutrients.

Open drain. A ditch constructed to remove surplus water from wet land; may also include cross slope ditches on sloping land.

Organic matter. A general term for plant and animal material, in or on the soil, in all stages of decomposition. Readily decomposed organic matter is often distinguished from the more stable forms that are past the stage of rapid decomposition.

Pan. A layer in a soil that is firmly compacted or very rich in clay. Frequently the word "pan" is combined with other words that more explicitly indicate the nature of the layers; for example, hardpan, fragipan, claypan, and traffic pan.

Parent material, soil. The disintegrated and partly weathered rock from which soil has formed.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Permeability, soil. The quality of a soil horizon that enables water or air to move through it. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid* and *very rapid.*

pH value. A numerical means for designating relatively weak acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value, alkalinity; and a lower value, acidity.

Porosity, soil. The degree to which the soil mass is permeated with pores or cavities.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour" soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Mildly alkaline	7.4 to 7.8
Very strongly acid	4.5 to 5.0	Moderately alkaline	7.9 to 8.4
Strongly acid	5.1 to 5.5	Strongly alkaline	8.5 to 9.0
Medium acid	5.6 to 6.0	Very strongly alkaline	9.1 and higher
Slightly acid	6.1 to 6.5		
Neutral	6.6 to 7.3		

Residual material. Unconsolidated, partly weathered mineral material that accumulates over disintegrated solid rock. Residual material is not soil but is frequently the material in which a soil has formed.

Rotation grazing. Grazing two or more pastures, or parts of a range in regular order, with definite recovery periods between grazing periods. Contrasts with continuous grazing.

Runoff. Refers to the amount of water removed by flow over the surface of the soil. The amount and rapidity of runoff are affected by factors such as texture, structure, and porosity of the surface soil; the prevailing climate; and the slope. The degree of runoff is expressed by the terms: *very rapid, rapid, medium, slow, very slow,* and *ponded.* The soil is presumed to be bare of vegetative covering when rated for runoff.

Sand. Individual rock or mineral fragments in soils having diameters ranging from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Sedimentary rock. A rock composed of particles deposited from suspension in water. The chief sedimentary rocks are conglomerate, from gravel; sandstone, from sand; shale, from clay; and limestone, from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sands have been consolidated into sandstone.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002) to the lower limit of very fine sand (0.05). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Single grain. See Structure, soil.

Site index. A numerical means of expressing the quality of a forest site that is based on the height of the dominant stand at an arbitrarily chosen age; for example, the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years.

Slope, soil. The incline of the surface of the soil. It is usually expressed in percent of slope, which is the number of feet of fall per 100 feet of horizontal distance. The slope classes used in this report are:

	Percent
Nearly level	0 to 3
Gently sloping	3 to 8
Strongly sloping	8 to 15
Moderately steep	15 to 25
Steep	25 to 45
Very steep	More than 45

Soil variant. A soil having properties sufficiently different from those of other known soils to suggest establishing a new soil series, but a soil of such limited known area that creation of a new series is not believed to be justified.

Solum. The upper part of the soil profile above the parent material in which the processes of soil formation are active. The solum in mature soils includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying parent material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular) and *granular. Structureless* soils are (1) *single grain* (each grain by itself, as in dune sand) and (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically the part of the soil below the solum.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their usefulness or behavior.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay and clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tile, drain. Concrete or pottery pipe placed at suitable spacings and depths in the soil or subsoil to provide water outlets from the soil.

Topsoil. A presumed fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Type, soil. A subdivision of the soil series that is made on the basis of differences in the texture of the surface layer.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Variant, soil. A soil having properties sufficiently different from those of other known soils to suggest establishing a new soil series, but a soil of such limited known area that creation of a new series is not believed to be justified.

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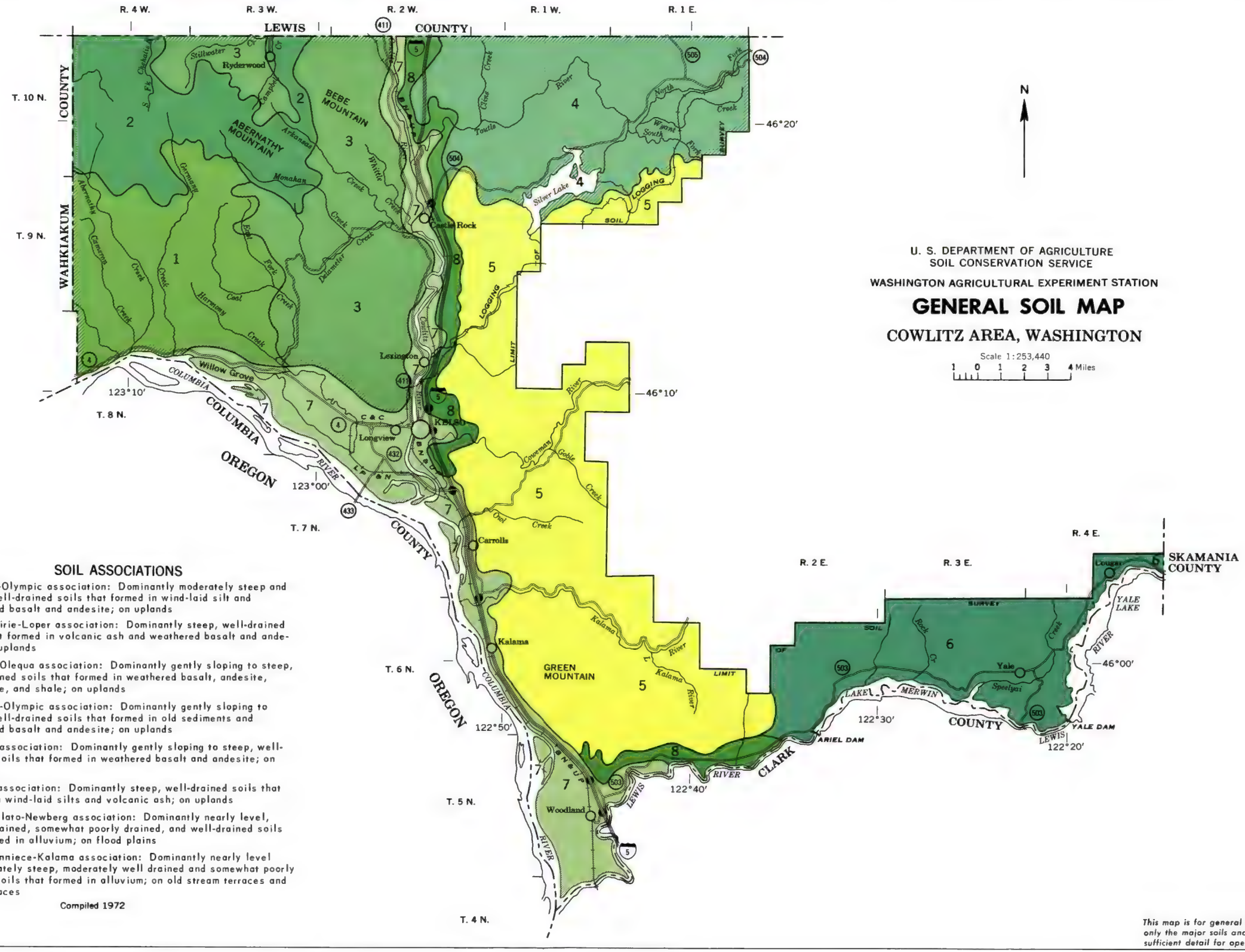


U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

WASHINGTON AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

COWLITZ AREA, WASHINGTON

Scale 1:253,440

1 0 1 2 3 4 Miles

SOIL ASSOCIATIONS

1 — Germany-Olympic association: Dominantly moderately steep and steep, well-drained soils that formed in wind-laid silt and weathered basalt and andesite; on uplands

2 — Bear Prairie-Loper association: Dominantly steep, well-drained soils that formed in volcanic ash and weathered basalt and andesite; on uplands

3 — Olympic-Olequa association: Dominantly gently sloping to steep, well-drained soils that formed in weathered basalt, andesite, sandstone, and shale; on uplands

4 — Seaquest-Olympic association: Dominantly gently sloping to steep, well-drained soils that formed in old sediments and weathered basalt and andesite; on uplands

5 — Olympic association: Dominantly gently sloping to steep, well-drained soils that formed in weathered basalt and andesite; on uplands

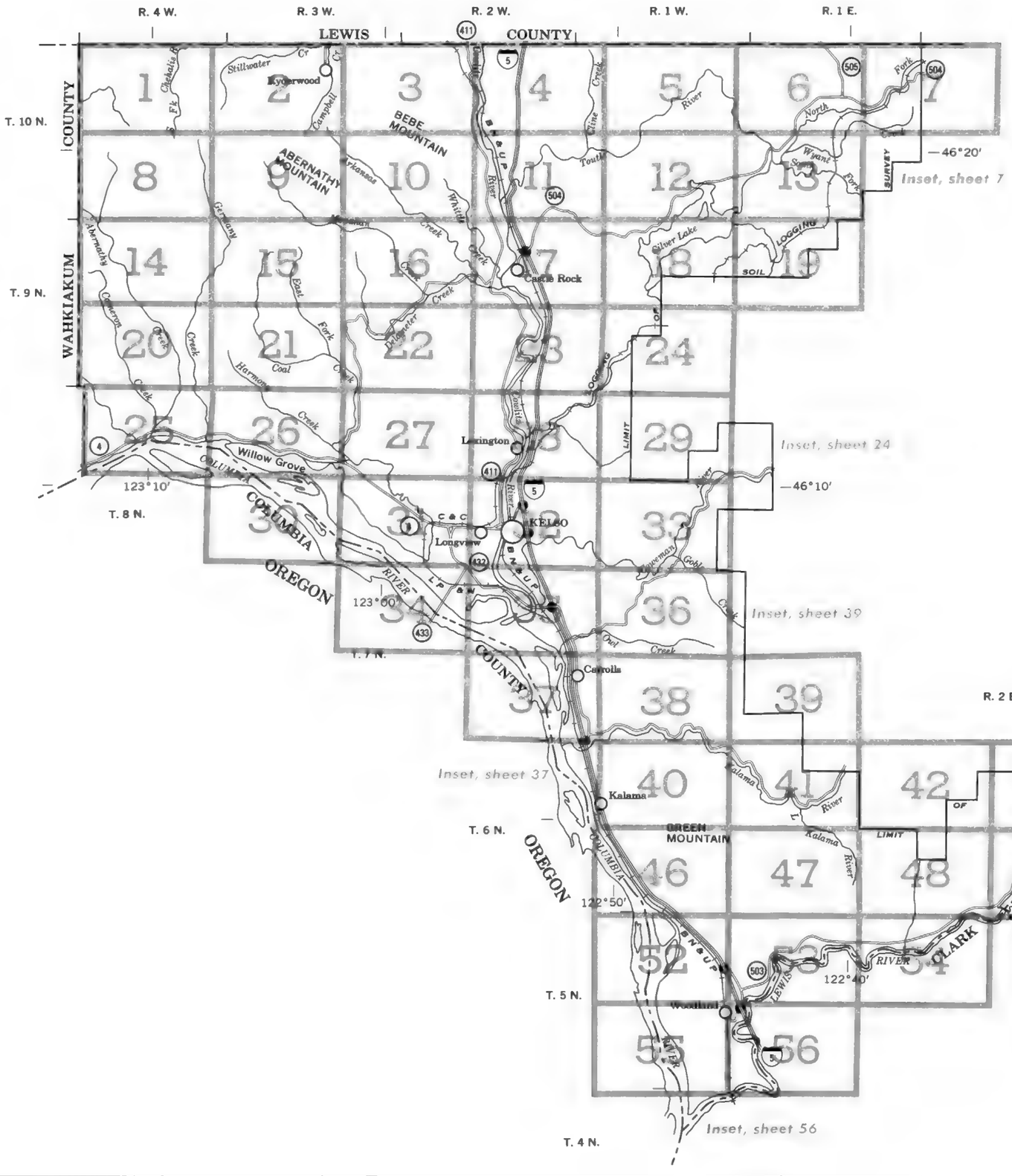
6 — Cinebar association: Dominantly steep, well-drained soils that formed in wind-laid silts and volcanic ash; on uplands

7 — Caples-Clato-Newberg association: Dominantly nearly level, poorly drained, somewhat poorly drained, and well-drained soils that formed in alluvium; on flood plains

8 — Kelso-Minniece-Kalama association: Dominantly nearly level to moderately steep, moderately well drained and somewhat poorly drained soils that formed in alluvium; on old stream terraces and lake terraces

Compiled 1972

This map is for general planning. It shows only the major soils and does not contain sufficient detail for operational planning.



INDEX TO MAP SHEETS

COWLITZ AREA, WASHINGTON

Scale 1:253,440

1 0 1 2 3 4 Miles

SOIL LEGEND

The first capital letter is the initial one of the soil name. A second capital letter, A, B, C, D, or E, shows the slope. Most symbols without a slope letter are those of nearly level soils, but some are for land types that have a considerable range in slope. The final number, 2, in a symbol shows that the soil is eroded.

SYMBOL	NAME
BpC	Bear Prairie silt loam, 3 to 15 percent slopes
BpD	Bear Prairie silt loam, 15 to 30 percent slopes
BpD2	Bear Prairie silt loam, 15 to 30 percent slopes, eroded
BpE	Bear Prairie silt loam, 30 to 50 percent slopes
Ca	Camas cobbly loam
Ce	Caples silt loam
Ch	Caples silty clay loam
CmB	Cinebar loam, 0 to 8 percent slopes
CnC	Cinebar silt loam, 8 to 20 percent slopes
CnD	Cinebar silt loam, 20 to 30 percent slopes
CoB	Cinebar gravelly silt loam, 0 to 8 percent slopes
CoC	Cinebar gravelly silt loam, 8 to 20 percent slopes
CoD	Cinebar gravelly silt loam, 20 to 30 percent slopes
CoE	Cinebar gravelly silt loam, 30 to 50 percent slopes
CsC	Cispus gravelly sandy loam, 8 to 20 percent slopes
CsE	Cispus gravelly sandy loam, 20 to 60 percent slopes
Ct	Clato silt loam
Cv	Clato silt loam, coarse variant
CwC	Coweeman silt loam, 5 to 15 percent slopes
CxD	Coweeman silty clay loam, 8 to 30 percent slopes
CyB	Coweeman silty clay loam, dark variant, 0 to 4 percent slopes
GeB	Gee silt loam, 0 to 8 percent slopes
GeC	Gee silt loam, 8 to 15 percent slopes
GeD	Gee silt loam, 15 to 40 percent slopes
GmB	Germany silt loam, 0 to 8 percent slopes
GmC	Germany silt loam, 8 to 20 percent slopes
GmD	Germany silt loam, 20 to 30 percent slopes
GmE	Germany silt loam, 30 to 50 percent slopes
GnD	Germany cobbly silt loam, 20 to 30 percent slopes
GnE	Germany cobbly silt loam, 30 to 50 percent slopes
Go	Godfrey silt loam
Gr	Godfrey silty clay loam
HlD	Hillsboro silt loam, 0 to 40 percent slopes
KaB	Kalama gravelly loam, 0 to 8 percent slopes
KaC	Kalama gravelly loam, 8 to 15 percent slopes
KaD	Kalama gravelly loam, 15 to 30 percent slopes
KaE	Kalama gravelly loam, 30 to 60 percent slopes
KeB	Kelso silt loam, 0 to 8 percent slopes
KeC	Kelso silt loam, 8 to 15 percent slopes
KeD	Kelso silt loam, 15 to 30 percent slopes
KeE	Kelso silt loam, 30 to 50 percent slopes
LbC	Loper-Bear Prairie complex, 3 to 15 percent slopes
LbD	Loper-Bear Prairie complex, 15 to 30 percent slopes
LbD2	Loper-Bear Prairie complex, 8 to 30 percent slopes, eroded
LbE	Loper-Bear Prairie complex, 30 to 50 percent slopes
Mb	McBee silty clay
Md	Made land
MrB	Mart silt loam, 0 to 8 percent slopes
MrC	Mart silt loam, 8 to 20 percent slopes
MrD	Mart silt loam, 20 to 30 percent slopes
MrE	Mart silt loam, 30 to 50 percent slopes
MtB	Minniece silt loam, 0 to 8 percent slopes
MtC	Minniece silt loam, 8 to 25 percent slopes
MvA	Minniece silt loam, loamy variant, 0 to 3 percent slopes
Ne	Newberg fine sandy loam
Nw	Newberg silt loam, silty variant
OeB	Olequa silt loam, 0 to 8 percent slopes
OeC	Olequa silt loam, 8 to 20 percent slopes
OeD	Olequa silt loam, 20 to 30 percent slopes
OeE	Olequa silt loam, 30 to 50 percent slopes
OlB	Olequa silt loam, moderately well drained variant, 3 to 8 percent slopes
OlC	Olequa silt loam, moderately well drained variant, 8 to 15 percent slopes
OmB	Olympic silt loam, 2 to 8 percent slopes
OmC	Olympic silt loam, 8 to 20 percent slopes
OmD	Olympic silt loam, 20 to 30 percent slopes
OmE	Olympic silt loam, 30 to 50 percent slopes
OpB	Olympic gravelly silt loam, 2 to 8 percent slopes
OpC	Olympic gravelly silt loam, 8 to 20 percent slopes
OpD	Olympic gravelly silt loam, 20 to 30 percent slopes
OpE	Olympic gravelly silt loam, 30 to 50 percent slopes
OyC	Olympic cobbly silt loam, 0 to 20 percent slopes
PcB	Pilchuck loamy fine sand, 0 to 8 percent slopes
Rh	Riverwash
Ro	Rock land
RvB	Rose Valley silt loam, 0 to 8 percent slopes
RvC	Rose Valley silt loam, 8 to 15 percent slopes
RvD	Rose Valley silt loam, 15 to 30 percent slopes
RyB	Rose Valley silt loam, thin surface variant, 0 to 6 percent slopes
SaB	Sara silt loam, 0 to 8 percent slopes
SaC	Sara silt loam, 8 to 15 percent slopes
SaD	Sara silt loam, 15 to 30 percent slopes
ScB	Sara silty clay loam, 0 to 8 percent slopes
SlB	Sauvola loam, 0 to 8 percent slopes
SlC	Sauvola loam, 8 to 15 percent slopes
SlD	Sauvola loam, 15 to 30 percent slopes
SmB	Seaquest silt loam, 0 to 8 percent slopes
SmC	Seaquest silt loam, 8 to 20 percent slopes
SmD	Seaquest silt loam, 20 to 30 percent slopes
Sp	Semiahmoo peat
SrB	Sifton gravelly loam, 0 to 8 percent slopes
Ss	Snohomish silty clay loam
SyB	Speelyai gravelly loamy sand, 0 to 8 percent slopes
SyE	Speelyai gravelly loamy sand, 15 to 60 percent slopes
ToB	Toutle loamy sand, 0 to 8 percent slopes
ToD	Toutle loamy sand, 8 to 40 percent slopes
TtB	Toutle gravelly loamy sand, 0 to 8 percent slopes
TuB	Toutle fine sandy loam, 0 to 8 percent slopes
TuD	Toutle fine sandy loam, 15 to 45 percent slopes
VaD	Vader loam, 8 to 30 percent slopes
VaE	Vader loam, 30 to 50 percent slopes

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Divided
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State or county

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail
- Railroad
- Ferry (FY)
- Ford (FORD)

Grade
R. R. over
R. R. under
Buildings
School
Church
Mine and quarry
Gravel pit
Power line
Pipeline
Cemetery
Dams
Levee
Tanks
Well, oil or gas
Forest fire or lookout station
Windmill
Sawmill

BOUNDARIES

National or state
County
Limit of soil survey
Reservation
Land grant
Small park, cemetery, airport
Land survey division corners

DRAINAGE

Streams, double-line
- Perennial
- Intermittent

Streams, single-line
- Perennial
- Intermittent
  - Crossable with tillage implements
  - Not crossable with tillage implements
  - Unclassified

Canals and ditches
Lakes and ponds
- Perennial (water, w)
- Intermittent (int)

Spring
Marsh or swamp
Wet spot
Drainage end or alluvial fan

RELIEF

Escarpments
- Bedrock
- Other

Short steep slope
Prominent peak
Depressions

	Large	Small
Crossable with tillage implements		
Not crossable with tillage implements		
Contains water most of the time		

SOIL SURVEY DATA

Soil boundary and symbol (Dx)
Gravel
Stoniness
- Stony
- Very stony

Rock outcrops
Chert fragments
Clay spot
Sand spot
Gumbo or scabby spot
Made land
Severely eroded spot
Blowout, wind erosion
Gully

GUIDE TO MAPPING UNITS

For complete information about a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. In referring to a capability unit, read the introduction to the section it is in for general information about its management. For information about the suitability of the soils as woodland and wildlife habitat, refer to the sections "Woodland" and "Wildlife and Fish." See table 3 for data on woodland group. See pages 70 and 71 for descriptions of wildlife groups. Other information is given in tables as follows:

Acreage and extent, table 1, page 10.
Estimated yields, table 2, page 58.

Engineering uses of soils, tables 5 and 6, pages 72 through 89.
Soil limitations for town and country planning, table 7, page 92.

Map symbol	Mapping unit	Described on page	Capability unit		Woodland group	Wildlife group
			Symbol	Page	Symbol	Number
BpC	Bear Prairie silt loam, 3 to 15 percent slopes	9	IIIe-3	52	3o1	8
BpD	Bear Prairie silt loam, 15 to 30 percent slopes	9	IVe-2	55	3o1	8
BpD2	Bear Prairie silt loam, 15 to 30 percent slopes, eroded	11	IVe-2	55	3d4	8
BpE	Bear Prairie silt loam, 30 to 50 percent slopes	9	VIe-1	57	3r1	8
Ca	Camas cobbly loam	12	VIs-2	58	3f1	9
Ce	Caples silt loam	12	IIw-1	51	---	1
Ch	Caples silty clay loam	13	IIw-1	51	---	1
CmB	Cinebar loam, 0 to 8 percent slopes	15	IVe-7	56	2o2	5
CnC	Cinebar silt loam, 8 to 20 percent slopes	14	IVe-7	56	2o2	5
CnD	Cinebar silt loam, 20 to 30 percent slopes	14	IVe-7	56	2o2	7
CoB	Cinebar gravelly silt loam, 0 to 8 percent slopes	14	IVe-7	56	2o2	5
CoC	Cinebar gravelly silt loam, 8 to 20 percent slopes	14	IVe-7	56	2o1	5
CoD	Cinebar gravelly silt loam, 20 to 30 percent slopes	14	IVe-7	56	2o2	7
CoE	Cinebar gravelly silt loam, 30 to 50 percent slopes	14	VIe-1	57	2r1	7
CsC	Cispus gravelly sandy loam, 8 to 20 percent slopes	15	IVe-9	57	3s1	9
CsE	Cispus gravelly sandy loam, 20 to 60 percent slopes	15	VIe-3	58	3s1	9
Ct	Clato silt loam	15	I-1	49	---	2
Cv	Clato silt loam, coarse variant	16	IIw-2	52	3d3	2
CwC	Coweeman silt loam, 5 to 15 percent slopes	18	IIIe-4	53	3d2	3
CxD	Coweeman silty clay loam, 8 to 30 percent slopes	17	IVe-6	56	3d2	3
CyB	Coweeman silty clay loam, dark variant, 0 to 4 percent slopes	18	IVw-2	57	4d1	3
GeB	Gee silt loam, 0 to 8 percent slopes	20	IIIe-2	52	3d3	1
GeC	Gee silt loam, 8 to 15 percent slopes	19	IIIe-2	52	3d3	1
GeD	Gee silt loam, 15 to 40 percent slopes	20	VIe-1	57	3d3	3
GmB	Germany silt loam, 0 to 8 percent slopes	20	IIe-2	49	1o1	4
GmC	Germany silt loam, 8 to 20 percent slopes	21	IIIe-1	52	1o1	4
GmD	Germany silt loam, 20 to 30 percent slopes	20	IVe-1	54	1o1	7
GmE	Germany silt loam, 30 to 50 percent slopes	21	VIe-1	57	1r1	7
GnD	Germany cobbly silt loam, 20 to 30 percent slopes	21	IVe-1	54	1o1	7
GnE	Germany cobbly silt loam, 30 to 50 percent slopes	21	VIe-1	57	1r1	7
Go	Godfrey silt loam	21	IIIw-2	54	3d2	3
Gr	Godfrey silty clay loam	21	IIIw-2	54	3d2	3
HlD	Hillsboro silt loam, 0 to 40 percent slopes:	22				
	0 to 8 percent slopes	--	IIe-1	49	3o1	2
	8 to 30 percent slopes	--	IVe-1	54	3o1	2
	30 to 40 percent slopes	--	VIe-1	57	3r1	7
KaB	Kalama gravelly loam, 0 to 8 percent slopes	24	IIIe-2	52	3d1	4
KaC	Kalama gravelly loam, 8 to 15 percent slopes	24	IIIe-2	52	3d1	4
KaD	Kalama gravelly loam, 15 to 30 percent slopes	23	IVe-1	54	3d1	7
KaE	Kalama gravelly loam, 30 to 60 percent slopes	24	VIe-1	57	3d1	7
KeB	Kelso silt loam, 0 to 8 percent slopes	24	IIe-3	50	2o1	4
KeC	Kelso silt loam, 8 to 15 percent slopes	25	IVe-3	55	2o1	4
KeD	Kelso silt loam, 15 to 30 percent slopes	25	IVe-3	55	2o1	7
KeE	Kelso silt loam, 30 to 50 percent slopes	25	VIe-1	57	2r1	7
LbC	Loper-Bear Prairie complex, 3 to 15 percent slopes	25	IIIe-3	52	3d4	8
LbD	Loper-Bear Prairie complex, 15 to 30 percent slopes	25	IVe-2	55	3d4	8
LbD2	Loper-Bear Prairie complex, 8 to 30 percent slopes, eroded	26	IVe-2	55	3d4	8
LbE	Loper-Bear Prairie complex, 30 to 50 percent slopes	26	VIe-1	57	3d4	8
Mb	McBee silty clay	28	IIw-1	51	3d2	1
Md	Made land	27	VIIIs-1	59	---	--
MrB	Mart silt loam, 0 to 8 percent slopes	27	IIe-2	49	2o3	4
MrC	Mart silt loam, 8 to 20 percent slopes	27	IIIe-1	52	2o3	4
MrD	Mart silt loam, 20 to 30 percent slopes	27	IVe-1	54	2o3	7
MrE	Mart silt loam, 30 to 50 percent slopes	27	VIe-1	57	2r1	7
MtB	Minniece silt loam, 0 to 8 percent slopes	28	IIIw-1	54	3d2	1
MtC	Minniece silt loam, 8 to 25 percent slopes	29	IVe-4	55	3d2	3
MvA	Minniece silt loam, loamy variant, 0 to 3 percent slopes	29	IIIw-1	54	3d2	3
Ne	Newberg fine sandy loam	30	I-1	49	---	2
Nw	Newberg silt loam, silty variant	31	IIw-1	51	---	1
OeB	Olequa silt loam, 0 to 8 percent slopes	32	IIe-1	49	2o2	2
OeC	Olequa silt loam, 8 to 20 percent slopes	33	IIIe-1	52	2o2	2
OeD	Olequa silt loam, 20 to 30 percent slopes	33	IVe-1	54	2o2	7
OeE	Olequa silt loam, 30 to 50 percent slopes	33	VIe-1	57	2r1	7
OlB	Olequa silt loam, moderately well drained variant, 3 to 8 percent slopes	33	IIIe-2	52	3d3	4
OlC	Olequa silt loam, moderately well drained variant, 8 to 15 percent slopes	34	IIIe-2	52	3d3	4
OmB	Olympic silt loam, 2 to 8 percent slopes	34	IIe-2	49	2o3	4
OmC	Olympic silt loam, 8 to 20 percent slopes	35	IIIe-1	52	2o3	4
OmD	Olympic silt loam, 20 to 30 percent slopes	35	IVe-1	54	2o3	7
OmE	Olympic silt loam, 30 to 50 percent slopes	35	VIe-1	57	2r1	7
OpB	Olympic gravelly silt loam, 2 to 8 percent slopes	35	IIe-2	49	3o1	4
OpC	Olympic gravelly silt loam, 8 to 20 percent slopes	35	IIIe-1	52	3o1	4
OpD	Olympic gravelly silt loam, 20 to 30 percent slopes	35	IVe-1	54	3o1	7
OpE	Olympic gravelly silt loam, 30 to 50 percent slopes	36	VIe-1	57	3r1	7
OyC	Olympic cobbly silt loam, 0 to 20 percent slopes	36	VIs-3	58	3f1	7
PcB	Pilchuck loamy fine sand, 0 to 8 percent slopes	36	VIs-2	58	---	10
Rh	Riverwash	36	VIIIw-1	59	---	10
Ro	Rock land	36	VIIs-1	59	3x1	6
RvB	Rose Valley silt loam, 0 to 8 percent slopes	37	IIIw-3	54	3d1	1
RvC	Rose Valley silt loam, 8 to 15 percent slopes	39	IVe-5	55	3d1	1
RvD	Rose Valley silt loam, 15 to 30 percent slopes	39	VIe-2	57	3d1	3
RyB	Rose Valley silt loam, thin surface variant, 0 to 6 percent slopes	39	IVw-1	57	4d1	3
SaB	Sara silt loam, 0 to 8 percent slopes	40	IIIe-2	52	3d2	1
SaC	Sara silt loam, 8 to 15 percent slopes	41	IIIe-2	52	3d2	1
SaD	Sara silt loam, 15 to 30 percent slopes	41	IVe-1	54	3d2	3
ScB	Sara silty clay loam, 0 to 8 percent slopes	41	IIIw-2	54	3d2	1
SlB	Sauvola loam, 0 to 8 percent slopes	41	IIIe-2	52	3d3	4
SlC	Sauvola loam, 8 to 15 percent slopes	42	IIIe-2	52	3d3	4

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Map symbol	Mapping unit	Described on page	Capability unit		Woodland group	Wildlife group
			Symbol	Page	Symbol	Number
SlD	Sauvola loam, 15 to 30 percent slopes	42	IVe-1	54	3d3	7
SmB	Seaquest silt loam, 0 to 8 percent slopes	42	IIe-2	49	2o3	4
SmC	Seaquest silt loam, 8 to 20 percent slopes	42	IIIe-1	52	2o3	4
SmD	Seaquest silt loam, 20 to 30 percent slopes	42	IVe-1	54	2o3	7
Sp	Semiahmoo peat	43	VIIIw-2	59	---	11
SrB	Sifton gravelly loam, 0 to 8 percent slopes	43	IVe-8	57	3f1	5
Ss	Snohomish silty clay loam	44	IIw-1	51	---	1
SyB	Speelyai gravelly loamy sand, 0 to 8 percent slopes	45	VIs-4	58	5d1	9
SyE	Speelyai gravelly loamy sand, 15 to 60 percent slopes	45	VIs-1	58	5d1	9
ToB	Toutle loamy sand, 0 to 8 percent slopes	46	VIs-2	58	3s1	9
ToD	Toutle loamy sand, 8 to 40 percent slopes	47	VIs-1	58	3s1	9
TtB	Toutle gravelly loamy sand, 0 to 8 percent slopes	47	VIs-2	58	3s1	9
TuB	Toutle fine sandy loam, 0 to 8 percent slopes	47	VIs-2	58	3s1	9
TuD	Toutle fine sandy loam, 15 to 45 percent slopes	47	VIe-3	58	3s1	9
VaD	Vader loam, 8 to 30 percent slopes	48	IVe-2	55	2o3	8
VaE	Vader loam, 30 to 50 percent slopes	47	VIe-1	57	2r1	8

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GUIDE TO MAPPING UNITS

For complete information about a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. In referring to a capability unit, read the introduction to the section it is in for general information about its management. For information about the suitability of the soils as woodland and wildlife habitat, refer to the sections "Woodland" and "Wildlife and Fish." See table 3 for data on woodland group. See pages 70 and 71 for descriptions of wildlife groups. Other information is given in tables as follows:

Acreage and extent, table 1, page 10.
Estimated yields, table 2, page 58.

Engineering uses of soils, tables 5 and 6, pages 72 through 89.
Soil limitations for town and country planning, table 7, page 92.

Map symbol	Mapping unit	Described on page	Capability unit		Woodland group	Wildlife group
			Symbol	Page	Symbol	Number
BpC	Bear Prairie silt loam, 3 to 15 percent slopes	9	IIIe-3	52	3o1	8
BpD	Bear Prairie silt loam, 15 to 30 percent slopes	9	IVe-2	55	3o1	8
BpD2	Bear Prairie silt loam, 15 to 30 percent slopes, eroded	11	IVe-2	55	3d4	8
BpE	Bear Prairie silt loam, 30 to 50 percent slopes	9	VIe-1	57	3r1	8
Ca	Camas cobbly loam	12	VIs-2	58	3f1	9
Ce	Caples silt loam	12	IIw-1	51	---	1
Ch	Caples silty clay loam	13	IIw-1	51	---	1
CmB	Cinebar loam, 0 to 8 percent slopes	15	IVe-7	56	2o2	5
CnC	Cinebar silt loam, 8 to 20 percent slopes	14	IVe-7	56	2o2	5
CnD	Cinebar silt loam, 20 to 30 percent slopes	14	IVe-7	56	2o2	7
CoB	Cinebar gravelly silt loam, 0 to 8 percent slopes	14	IVe-7	56	2o2	5
CoC	Cinebar gravelly silt loam, 8 to 20 percent slopes	14	IVe-7	56	2o1	5
CoD	Cinebar gravelly silt loam, 20 to 30 percent slopes	14	IVe-7	56	2o2	7
CoE	Cinebar gravelly silt loam, 30 to 50 percent slopes	14	VIe-1	57	2r1	7
CsC	Cispus gravelly sandy loam, 8 to 20 percent slopes	15	IVe-9	57	3s1	9
CsE	Cispus gravelly sandy loam, 20 to 60 percent slopes	15	VIe-3	58	3s1	9
Ct	Clato silt loam	15	I-1	49	---	2
Cv	Clato silt loam, coarse variant	16	IIw-2	52	3d3	2
CwC	Coweeman silt loam, 5 to 15 percent slopes	18	IIIe-4	53	3d2	3
CxD	Coweeman silty clay loam, 8 to 30 percent slopes	17	IVe-6	56	3d2	3
CyB	Coweeman silty clay loam, dark variant, 0 to 4 percent slopes	18	IVw-2	57	4d1	3
GeB	Gee silt loam, 0 to 8 percent slopes	20	IIIe-2	52	3d3	1
GeC	Gee silt loam, 8 to 15 percent slopes	19	IIIe-2	52	3d3	1
GeD	Gee silt loam, 15 to 40 percent slopes	20	VIe-1	57	3d3	3
GmB	Germany silt loam, 0 to 8 percent slopes	20	IIe-2	49	1o1	4
GmC	Germany silt loam, 8 to 20 percent slopes	21	IIIe-1	52	1o1	4
GmD	Germany silt loam, 20 to 30 percent slopes	20	IVe-1	54	1o1	7
GmE	Germany silt loam, 30 to 50 percent slopes	21	VIe-1	57	1r1	7
GnD	Germany cobbly silt loam, 20 to 30 percent slopes	21	IVe-1	54	1o1	7
GnE	Germany cobbly silt loam, 30 to 50 percent slopes	21	VIe-1	57	1r1	7
Go	Godfrey silt loam	21	IIIw-2	54	3d2	3
Gr	Godfrey silty clay loam	21	IIIw-2	54	3d2	3
HlD	Hillsboro silt loam, 0 to 40 percent slopes:	22				
	0 to 8 percent slopes	--	IIe-1	49	3o1	2
	8 to 30 percent slopes	--	IVe-1	54	3o1	2
	30 to 40 percent slopes	--	VIe-1	57	3r1	7
KaB	Kalama gravelly loam, 0 to 8 percent slopes	24	IIIe-2	52	3d1	4
KaC	Kalama gravelly loam, 8 to 15 percent slopes	24	IIIe-2	52	3d1	4
KaD	Kalama gravelly loam, 15 to 30 percent slopes	23	IVe-1	54	3d1	7
KaE	Kalama gravelly loam, 30 to 60 percent slopes	24	VIe-1	57	3d1	7
KeB	Kelso silt loam, 0 to 8 percent slopes	24	IIe-3	50	2o1	4
KeC	Kelso silt loam, 8 to 15 percent slopes	25	IVe-3	55	2o1	4
KeD	Kelso silt loam, 15 to 30 percent slopes	25	IVe-3	55	2o1	7
KeE	Kelso silt loam, 30 to 50 percent slopes	25	VIe-1	57	2r1	7
LbC	Loper-Bear Prairie complex, 3 to 15 percent slopes	25	IIIe-3	52	3d4	8
LbD	Loper-Bear Prairie complex, 15 to 30 percent slopes	25	IVe-2	55	3d4	8
LbD2	Loper-Bear Prairie complex, 8 to 30 percent slopes, eroded	26	IVe-2	55	3d4	8
LbE	Loper-Bear Prairie complex, 30 to 50 percent slopes	26	VIe-1	57	3d4	8
Mb	McBee silty clay	28	IIw-1	51	3d2	1
Md	Made land	27	VIIIs-1	59	---	--
MrB	Mart silt loam, 0 to 8 percent slopes	27	IIe-2	49	2o3	4
MrC	Mart silt loam, 8 to 20 percent slopes	27	IIIe-1	52	2o3	4
MrD	Mart silt loam, 20 to 30 percent slopes	27	IVe-1	54	2o3	7
MrE	Mart silt loam, 30 to 50 percent slopes	27	VIe-1	57	2r1	7
MtB	Minniece silt loam, 0 to 8 percent slopes	28	IIIw-1	54	3d2	1
MtC	Minniece silt loam, 8 to 25 percent slopes	29	IVe-4	55	3d2	3
MvA	Minniece silt loam, loamy variant, 0 to 3 percent slopes	29	IIIw-1	54	3d2	3
Ne	Newberg fine sandy loam	30	I-1	49	---	2
Nw	Newberg silt loam, silty variant	31	IIw-1	51	---	1
OeB	Olequa silt loam, 0 to 8 percent slopes	32	IIe-1	49	2o2	2
OeC	Olequa silt loam, 8 to 20 percent slopes	33	IIIe-1	52	2o2	2
OeD	Olequa silt loam, 20 to 30 percent slopes	33	IVe-1	54	2o2	7
OeE	Olequa silt loam, 30 to 50 percent slopes	33	VIe-1	57	2r1	7
OlB	Olequa silt loam, moderately well drained variant, 3 to 8 percent slopes	33	IIIe-2	52	3d3	4
OlC	Olequa silt loam, moderately well drained variant, 8 to 15 percent slopes	34	IIIe-2	52	3d3	4
OmB	Olympic silt loam, 2 to 8 percent slopes	34	IIe-2	49	2o3	4
OmC	Olympic silt loam, 8 to 20 percent slopes	35	IIIe-1	52	2o3	4
OmD	Olympic silt loam, 20 to 30 percent slopes	35	IVe-1	54	2o3	7
OmE	Olympic silt loam, 30 to 50 percent slopes	35	VIe-1	57	2r1	7
OpB	Olympic gravelly silt loam, 2 to 8 percent slopes	35	IIe-2	49	3o1	4
OpC	Olympic gravelly silt loam, 8 to 20 percent slopes	35	IIIe-1	52	3o1	4
OpD	Olympic gravelly silt loam, 20 to 30 percent slopes	35	IVe-1	54	3o1	7
OpE	Olympic gravelly silt loam, 30 to 50 percent slopes	36	VIe-1	57	3r1	7
OyC	Olympic cobbly silt loam, 0 to 20 percent slopes	36	VIs-3	58	3f1	7
PcB	Pilchuck loamy fine sand, 0 to 8 percent slopes	36	VIs-2	58	---	10
Rh	Riverwash	36	VIIIw-1	59	---	10
Ro	Rock land	36	VIIs-1	59	3x1	6
RvB	Rose Valley silt loam, 0 to 8 percent slopes	37	IIIw-3	54	3d1	1
RvC	Rose Valley silt loam, 8 to 15 percent slopes	39	IVe-5	55	3d1	1
RvD	Rose Valley silt loam, 15 to 30 percent slopes	39	VIe-2	57	3d1	3
RyB	Rose Valley silt loam, thin surface variant, 0 to 6 percent slopes	39	IVw-1	57	4d1	3
SaB	Sara silt loam, 0 to 8 percent slopes	40	IIIe-2	52	3d2	1
SaC	Sara silt loam, 8 to 15 percent slopes	41	IIIe-2	52	3d2	1
SaD	Sara silt loam, 15 to 30 percent slopes	41	IVe-1	54	3d2	3
ScB	Sara silty clay loam, 0 to 8 percent slopes	41	IIIw-2	54	3d2	1
SlB	Sauvola loam, 0 to 8 percent slopes	41	IIIe-2	52	3d3	4
SlC	Sauvola loam, 8 to 15 percent slopes	42	IIIe-2	52	3d3	4

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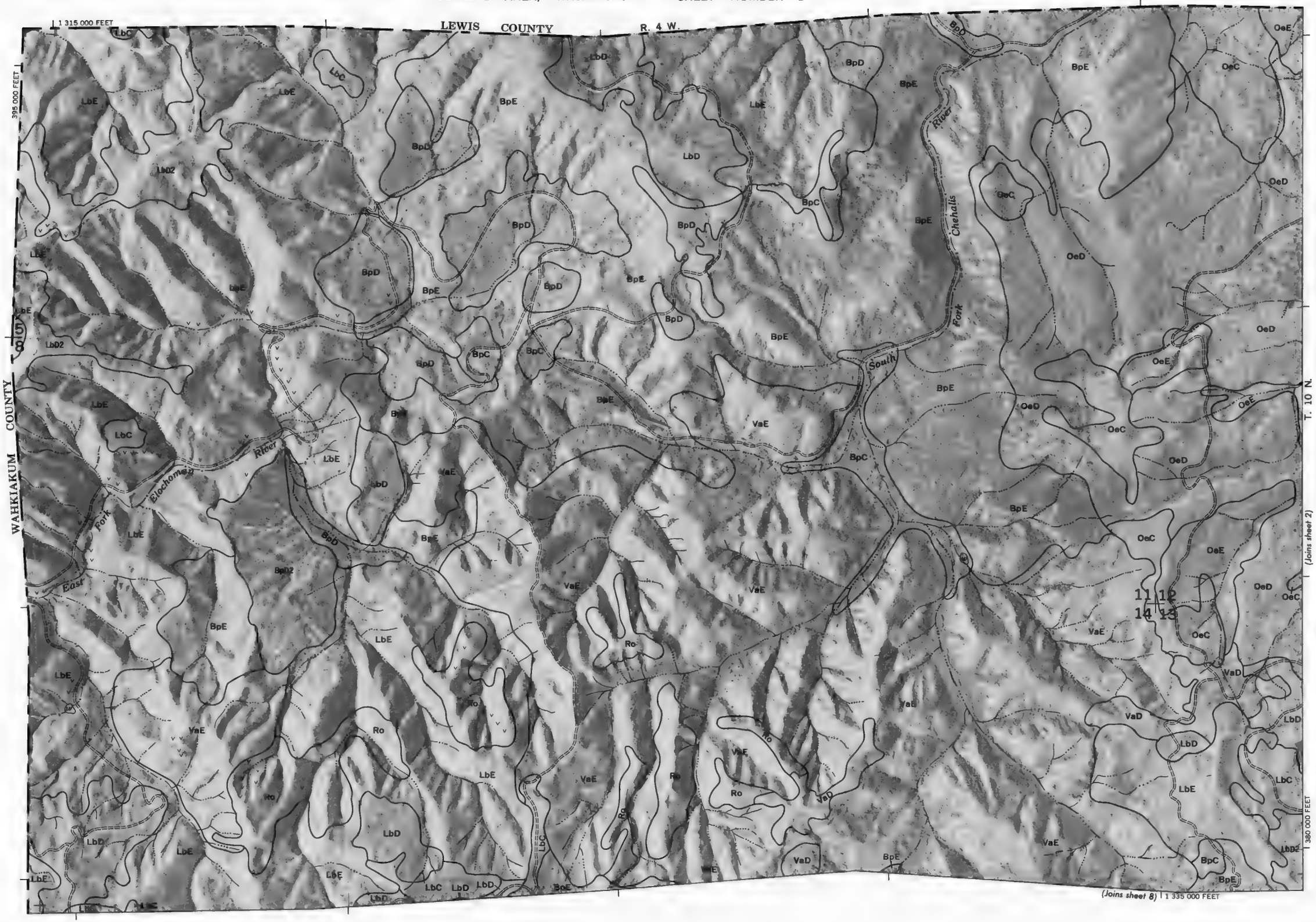
COWLITZ AREA, WASHINGTON — SHEET NUMBER 1



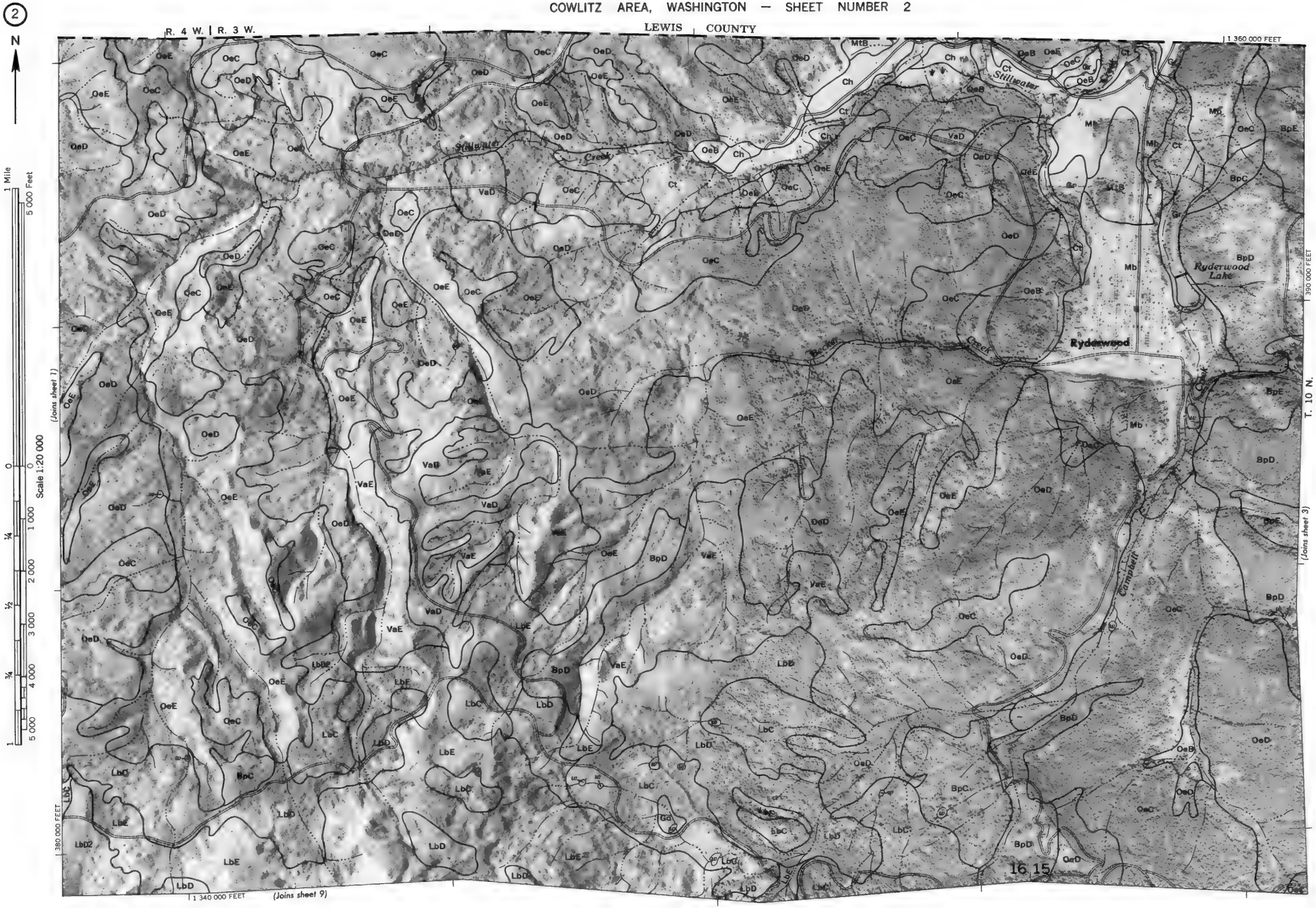
N

1 Mile
5 000 Feet
Scale 1:20 000

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.
Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.
Land division corners are approximately positioned on this map.

COWLITZ AREA, WASHINGTON NO. 1

COWLITZ AREA, WASHINGTON — SHEET NUMBER 2

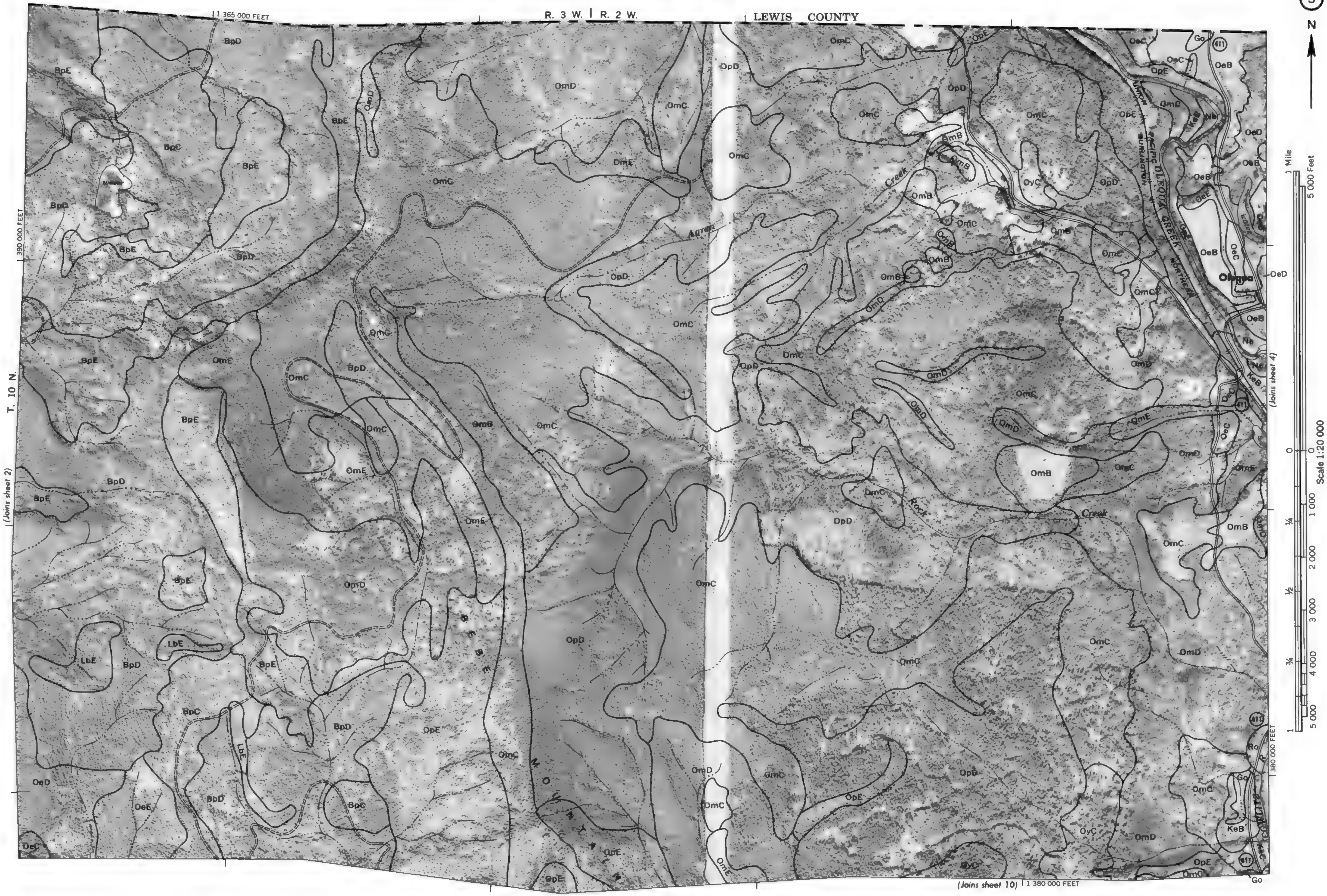


COWLITZ AREA, WASHINGTON NO. 2

Land division corners are approximately positioned on this map.

Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.



This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.
Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

COWLITZ AREA, WASHINGTON NO. 4

Land division corners are approximately positioned on this map.

Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

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COWLITZ AREA, WASHINGTON — SHEET NUMBER 5

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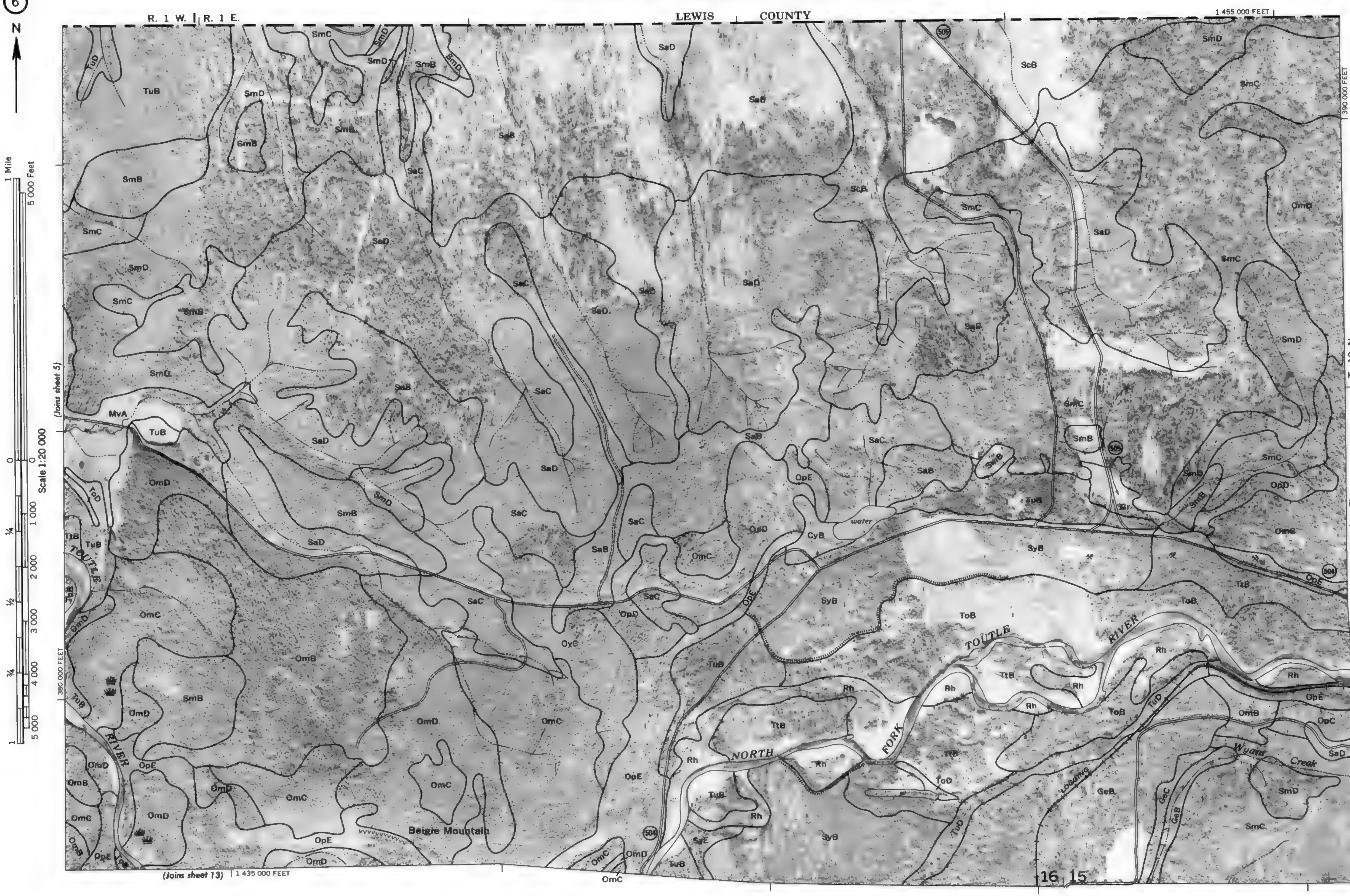
Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.
Land division corners are approximately positioned on this map.

COWLITZ AREA, WASHINGTON NO. 5

COWLITZ AREA, WASHINGTON — SHEET NUMBER 6

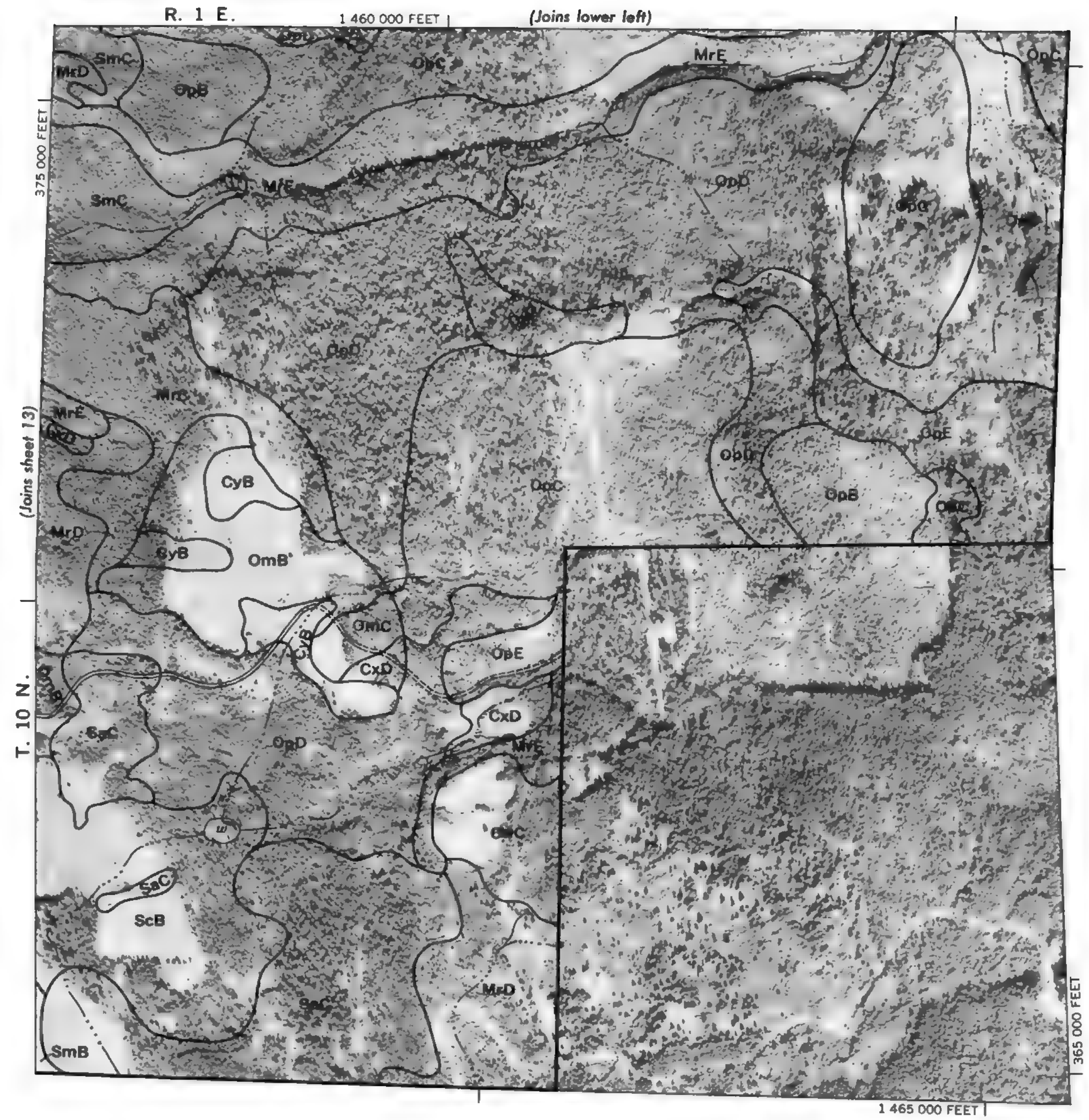


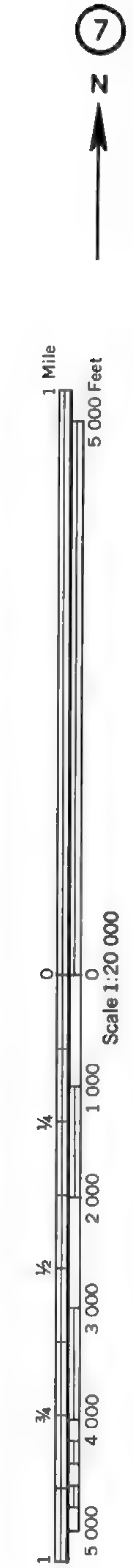
COWLITZ AREA, WASHINGTON NO. 6

Land division corners are approximately positioned on this map.

Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.





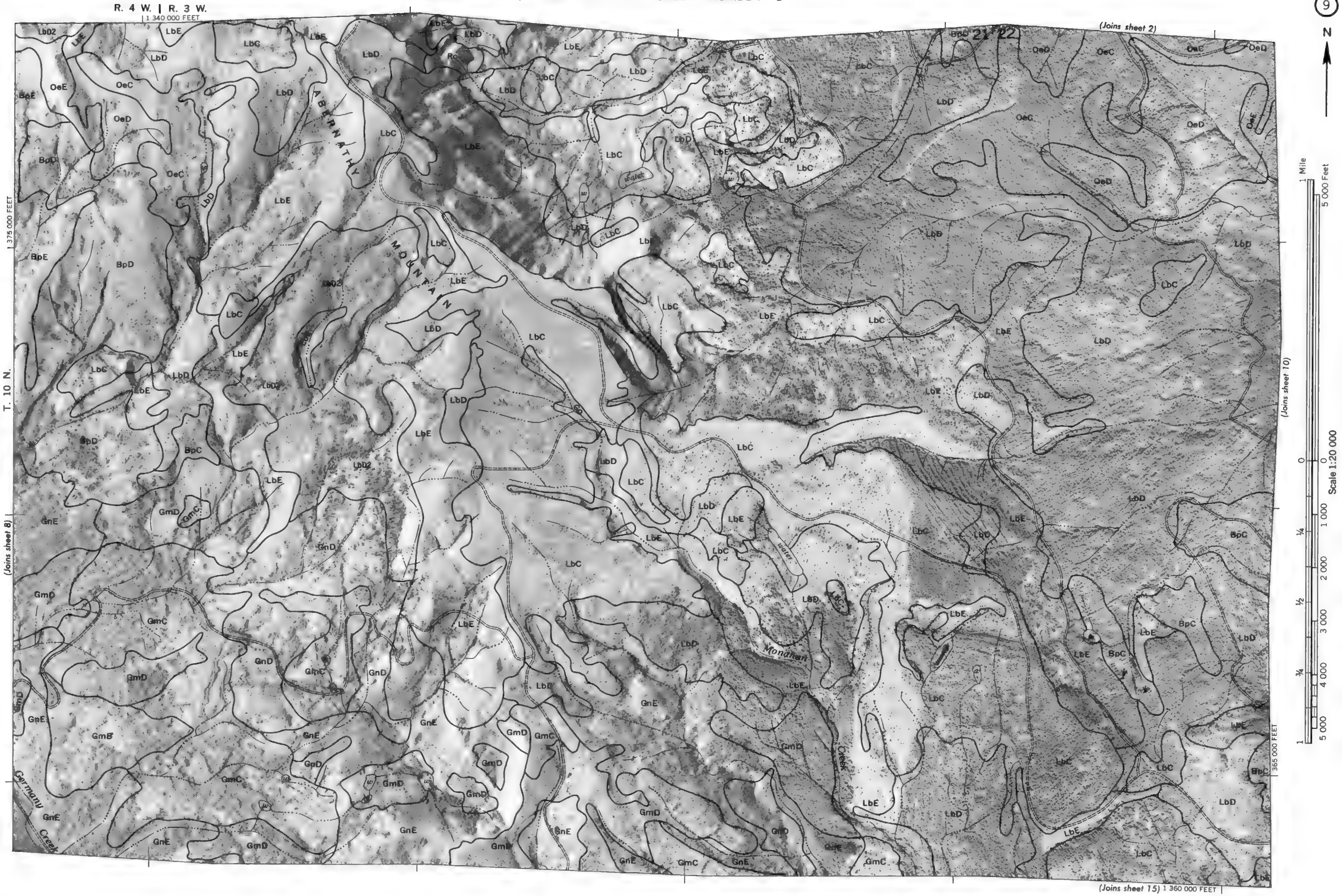
This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.
Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

COWLITZ AREA, WASHINGTON NO. 8

Land division corners are approximately positioned on this map

Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.

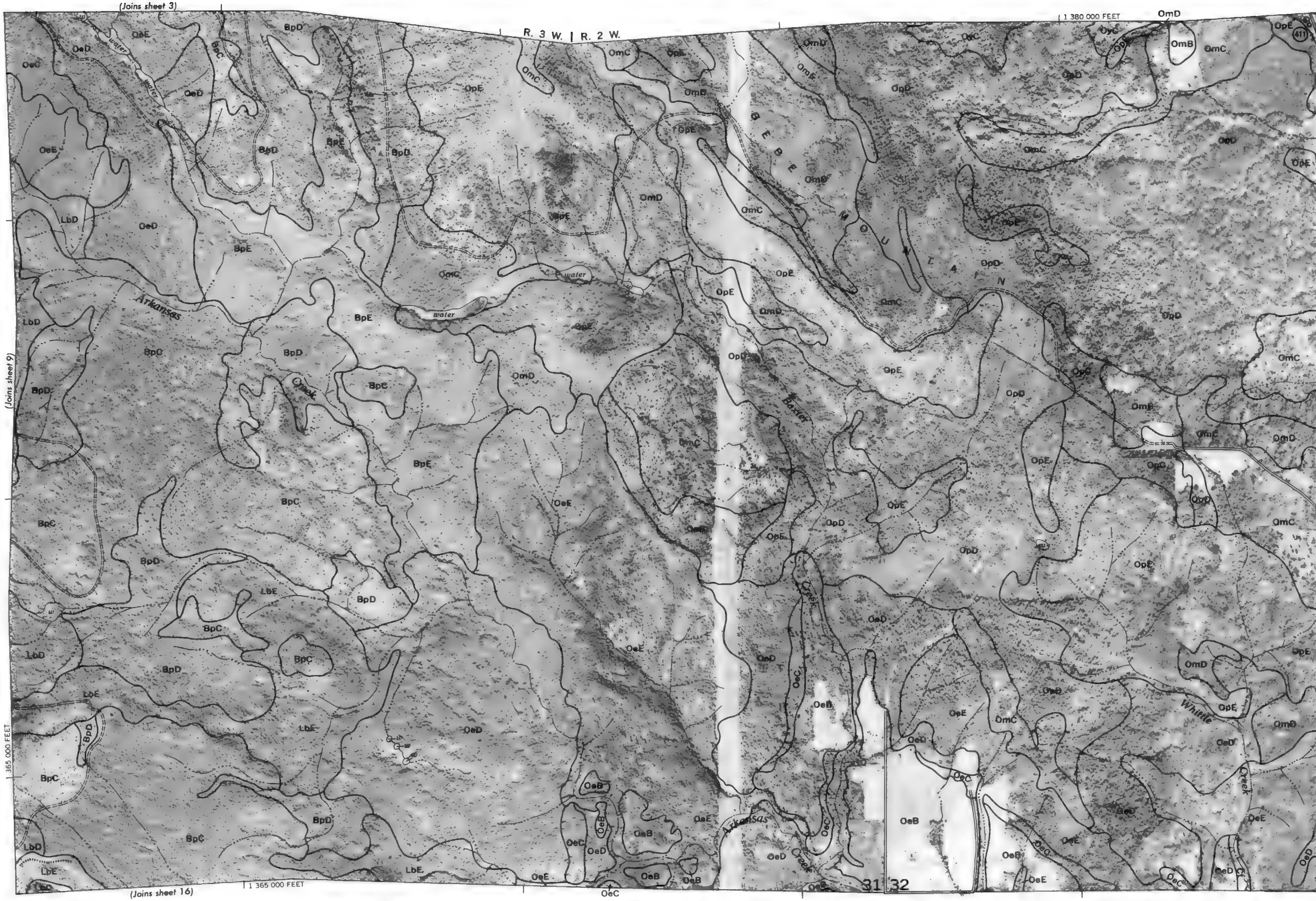


This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.
Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.
Land division corners are approximately positioned on this map.

COWLITZ AREA, WASHINGTON NO. 9

(10)

N



1 Mile
5 000 Feet
0
0
Scale 1:20 000
1/4
1 000
2 000
1/2
3 000
3/4
4 000
1
5 000

COWLITZ AREA, WASHINGTON NO. 10

Land division corners are approximately positioned on this map.

Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

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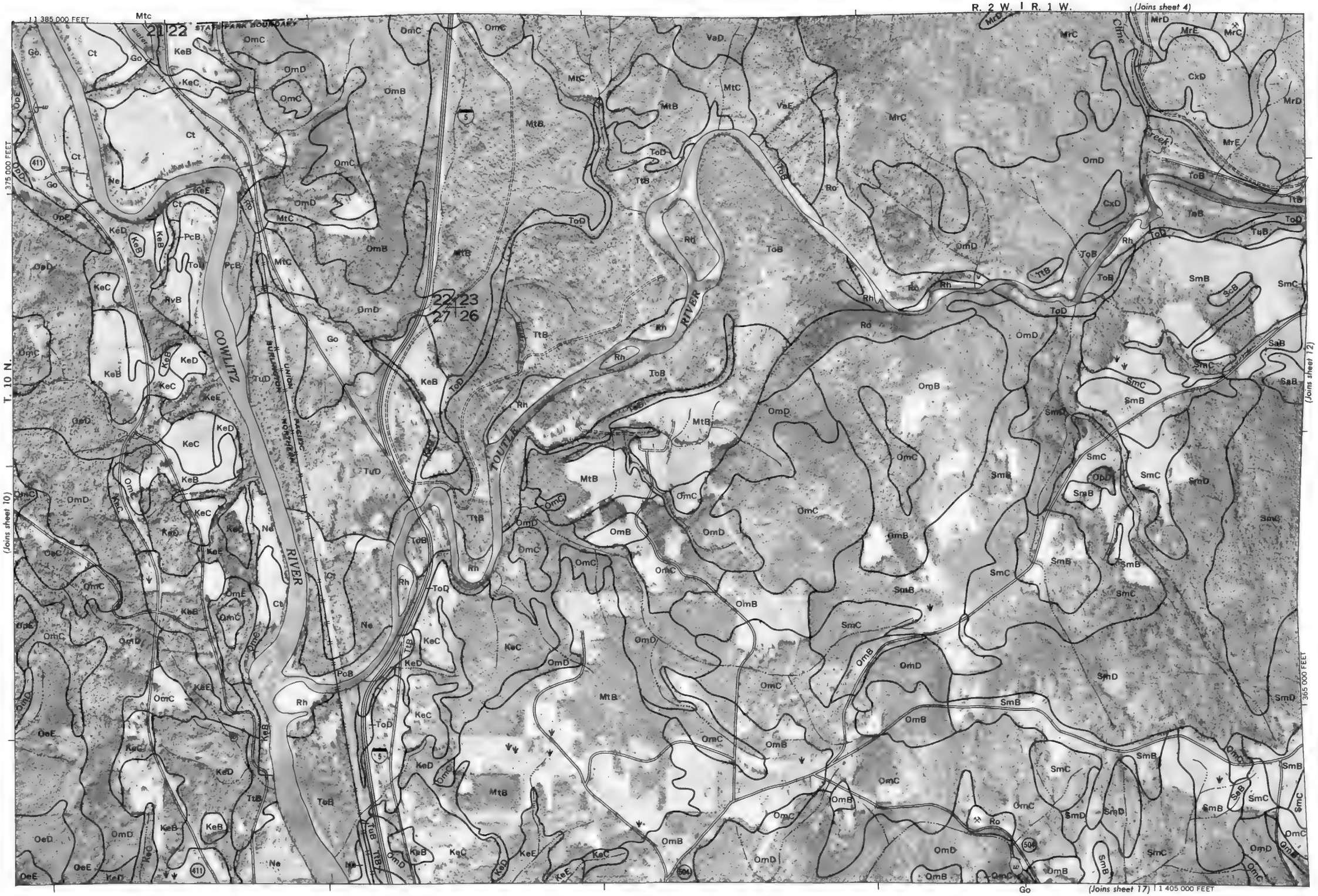
This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.
Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.
Land division corners are approximately positioned on this map.
COWLITZ AREA, WASHINGTON NO. 11



COWLITZ AREA, WASHINGTON NO. 12

Land division corners are approximately positioned on this map.

Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.

COWLITZ AREA, WASHINGTON — SHEET NUMBER 13

13

N

R. 1 W. | R. 1 E.

1 435 000 FEET

375 000 FEET

T. 10 N.

(Joins sheet 6)

(Joins sheet 12)

(Joins inset, sheet 7)

365 000 FEET

1 455 000 FEET

(Joins sheet 19)

Scale 1:20 000

1 Mile

5 000 Feet

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.
Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.
Land division corners are approximately positioned on this map.

COWLITZ AREA, WASHINGTON NO. 13

14

N

1 Mile
5 000 Feet
0
0
Scale 1:20 000
1 000
2 000
3 000
4 000
5 000
¼
½
¾
1

1 335 000 FEET

R. 4 W.

(Joins sheet 8)

360 000 FEET

T. 9 N.

WAHKIAKUM COUNTY

350 000 FEET

1 315 000 FEET (Joins sheet 20)

(Joins sheet 15)

Abernathy Creek
Midway Creek
Erick Creek
West Creek
Germany Creek
Cameron Creek
Slide Creek

GmB GmC GmD GmE BpD BpE LbC LbD2 LbD LbE GnE GnD Op Ca Sp Cv Go OmB OmC OmE

COWLITZ AREA, WASHINGTON NO. 14

Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University
Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

COWLITZ AREA, WASHINGTON NO. 15

15

N

1 Mile
5 000 Feet

Scale 1:20 000

1 5 000 ¾ 4 000 ½ 3 000 ¼ 2 000 0 1 000 0

16

N

R. 3 W. | R. 2 W.

(Joins sheet 10)

(Joins sheet 15)

(Joins sheet 22)

(Joins sheet 17)

1 380 000 FEET

1 350 000 FEET

1 365 000 FEET

360 000 FEET

T. 9 N.

65

1 Mile

5 000 Feet

Scale 1:20 000

Whittle Creek

Arkansas Creek

Monchem Creek

Delameter Creek

Tucker Creek

COWLITZ AREA, WASHINGTON NO. 16

Land division corners are approximately positioned on this map.

Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.
Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone

COWLITZ AREA, WASHINGTON NO. 17

17

N

COWLITZ AREA, WASHINGTON NO. 18

Photobase from 1964 aerial photographs; 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.

Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

COWLITZ AREA, WASHINGTON — SHEET NUMBER 20

20

N

R. 4 W.

1 335 000 FEET

(Joins Sheet 14)

T. 9 N.

1 345 000 FEET

1 335 000 FEET

1 315 000 FEET (Joins Sheet 25)

(Joins Sheet 21)

WAHKIAKUM COUNTY

Scale 1:20 000

1 Mile

5 000 Feet

0

0

1/4

1/2

3/4

1

1 000

2 000

3 000

4 000

5 000

Cameron Creek

Skate Creek

Brannan Creek

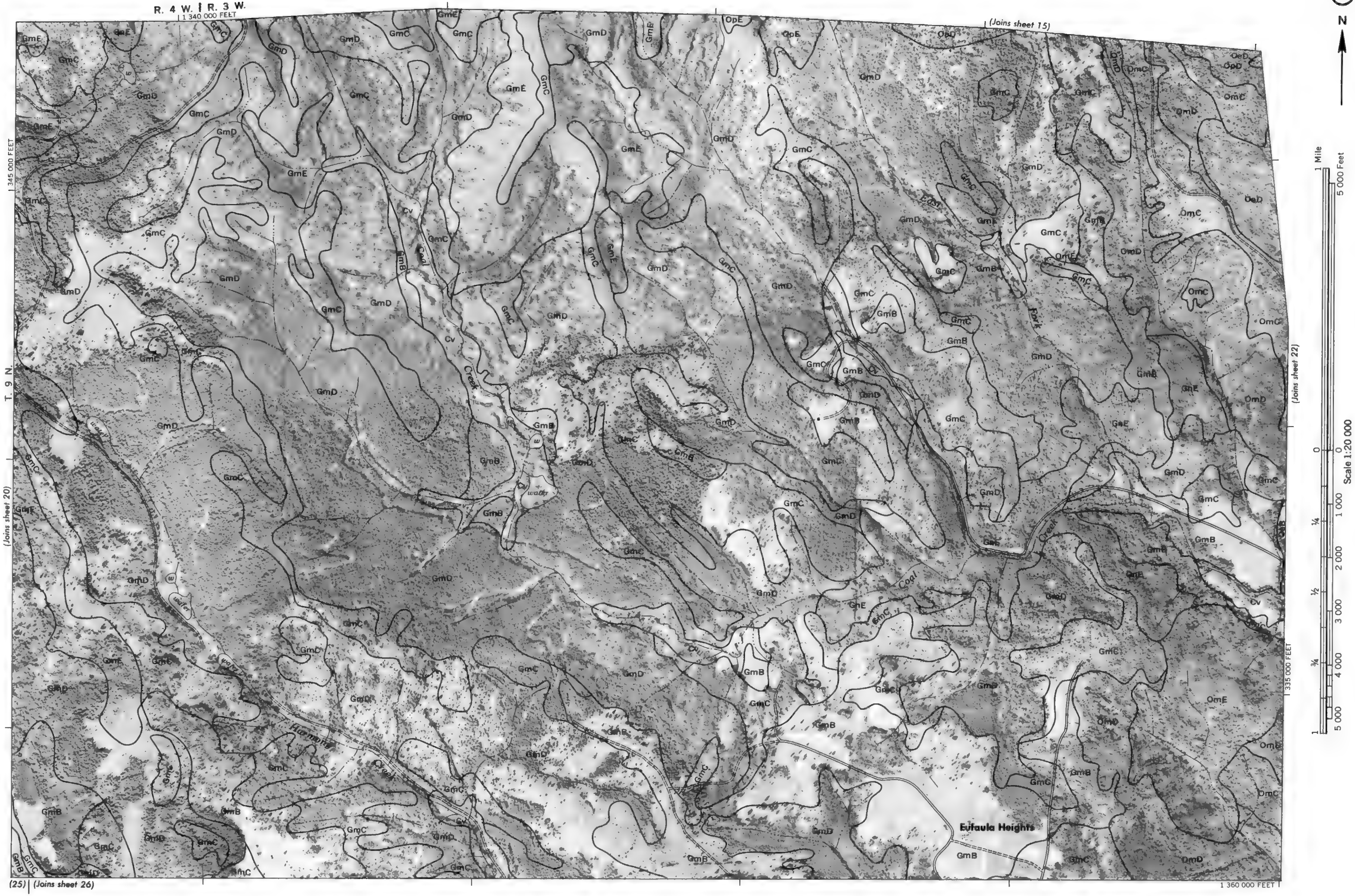
Germany Creek

Ca Cv GmB GmC GmD GmE Go Ct OmB OmC OmD OmE Rb

COWLITZ AREA, WASHINGTON NO. 20

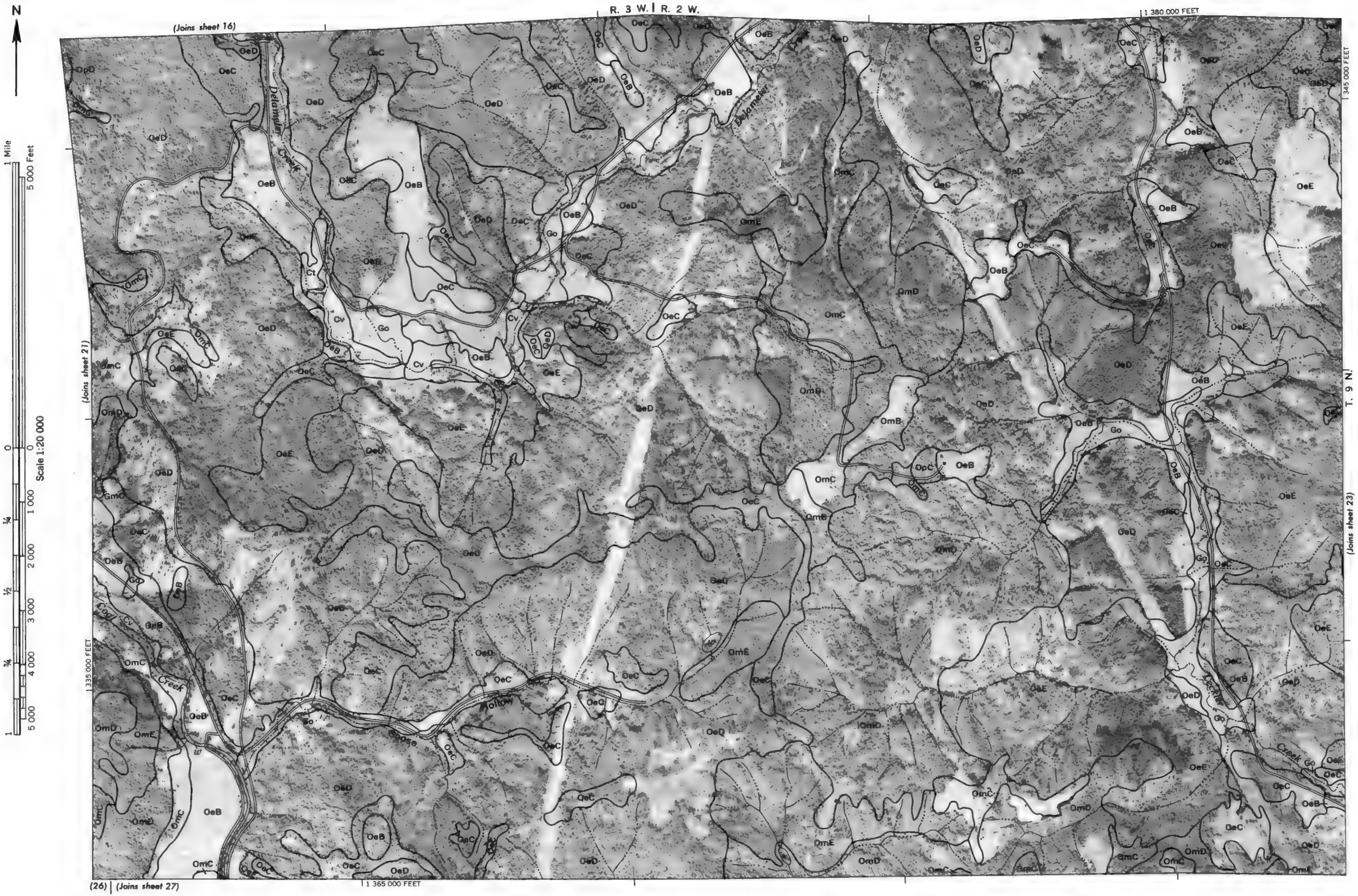
Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.



This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.
Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone

COWLITZ AREA, WASHINGTON NO. 21



COWLITZ AREA, WASHINGTON NO. 22

Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.
Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

COWLITZ AREA, WASHINGTON NO. 23

N

1 Mile

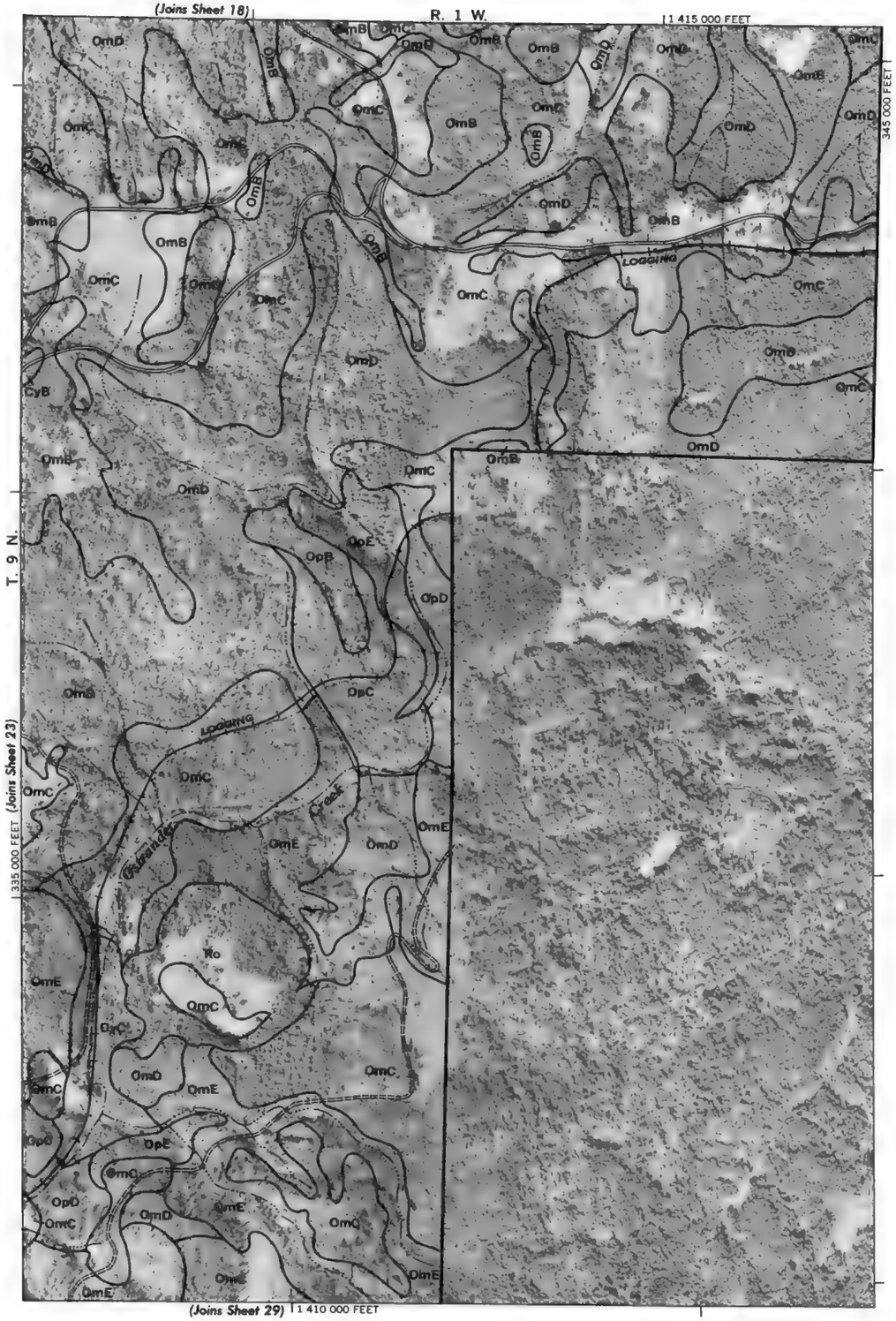
5 000 Feet

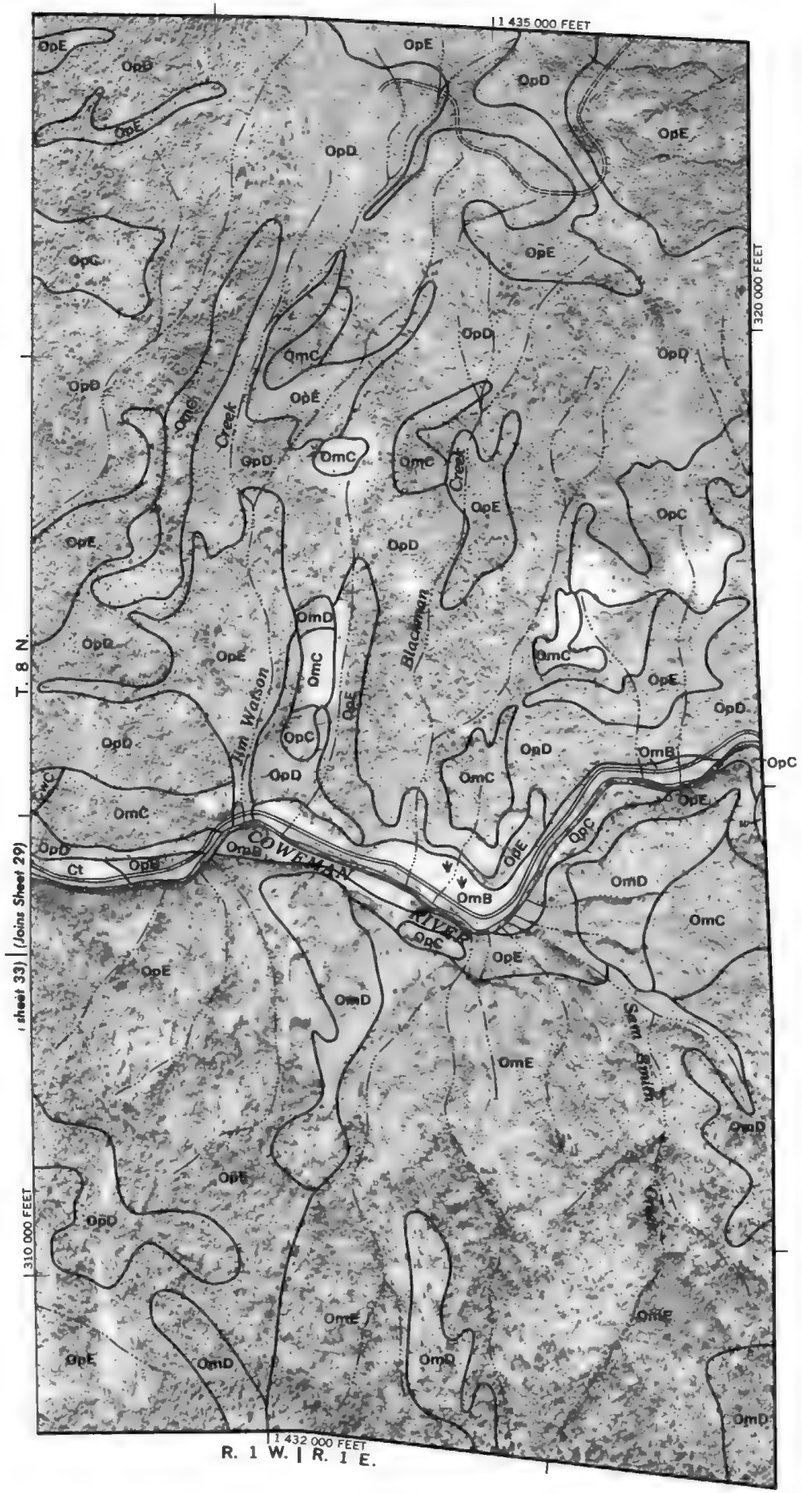
0 0

Scale 1:20 000

1 000 2 000 3 000 4 000 5 000

¼ ½ ¾ 1





5000 AND 3000 – FOOT GRID TICKS

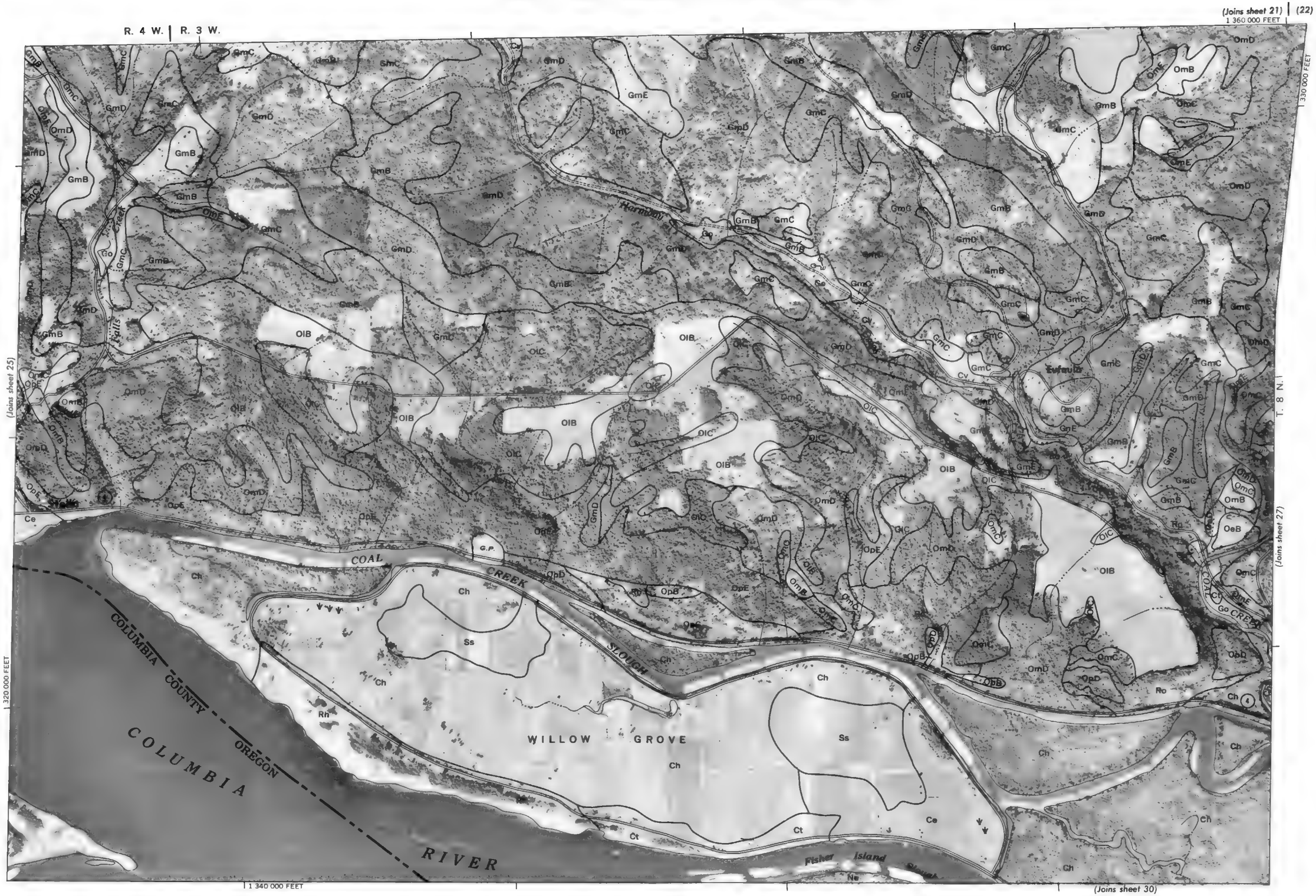
COWLITZ AREA, WASHINGTON NO. 24

Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.
Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

COWLITZ AREA, WASHINGTON NO. 25



COWLITZ AREA, WASHINGTON NO. 26

Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.
Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

COWLITZ AREA, WASHINGTON NO. 27

COWLITZ AREA, WASHINGTON NO. 28

Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.

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Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

29

N

R. 1 W. (Joins sheet 24) | 1 410 000 FEET

T. 8 N. | 325 000 FEET

(Joins sheet 28)

(Joins sheet 33)

R. 1 W. | 1 425 000 FEET

(Joins sheet 33)

(Joins inset, sheet 24)

| 315 000 FEET

T. 8 N.

Ostrander Creek

South Fork

COWEMAN RIVER

1 Mile

5 000 Feet

Scale 1:20 000

30

N

1 Mile 5 000 Feet

0 0

Scale 1:20 000

¾ ½ ¼ 0

5 000 4 000 3 000 2 000 1 000 0

1 335 000 FEET

1 305 000 FEET

R. 3 W. | 1 355 000 FEET *(Joins sheet 26)*

315 000 FEET

T. 8 N.

(Joins sheet 31)

COLUMBIA COUNTY OREGON

COLUMBIA RIVER

Fisher Island Slough

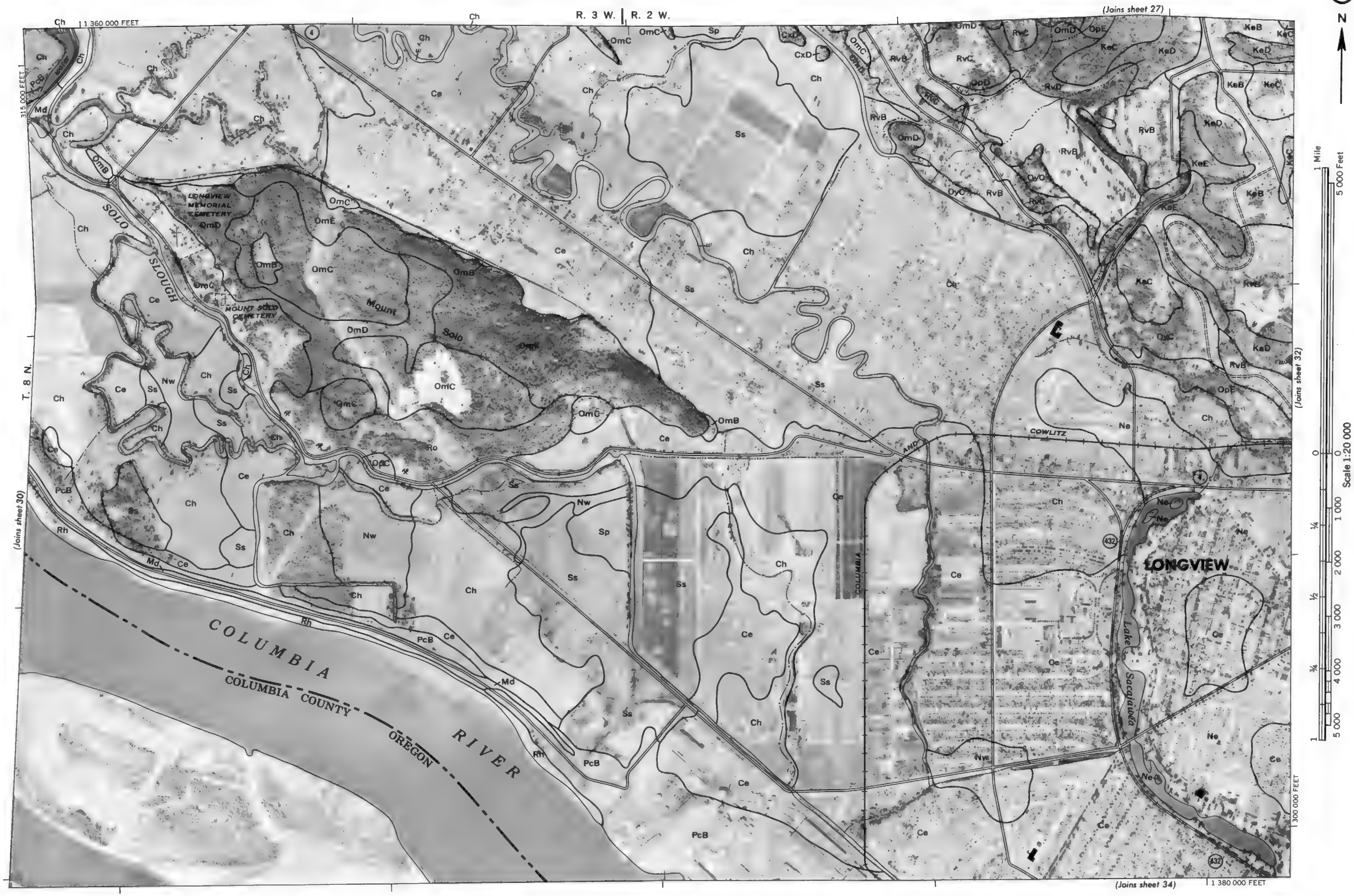
Fisher Island

Ce PcB Ns Cp PoB Md Ss Ch

COWLITZ AREA, WASHINGTON NO. 30

Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University



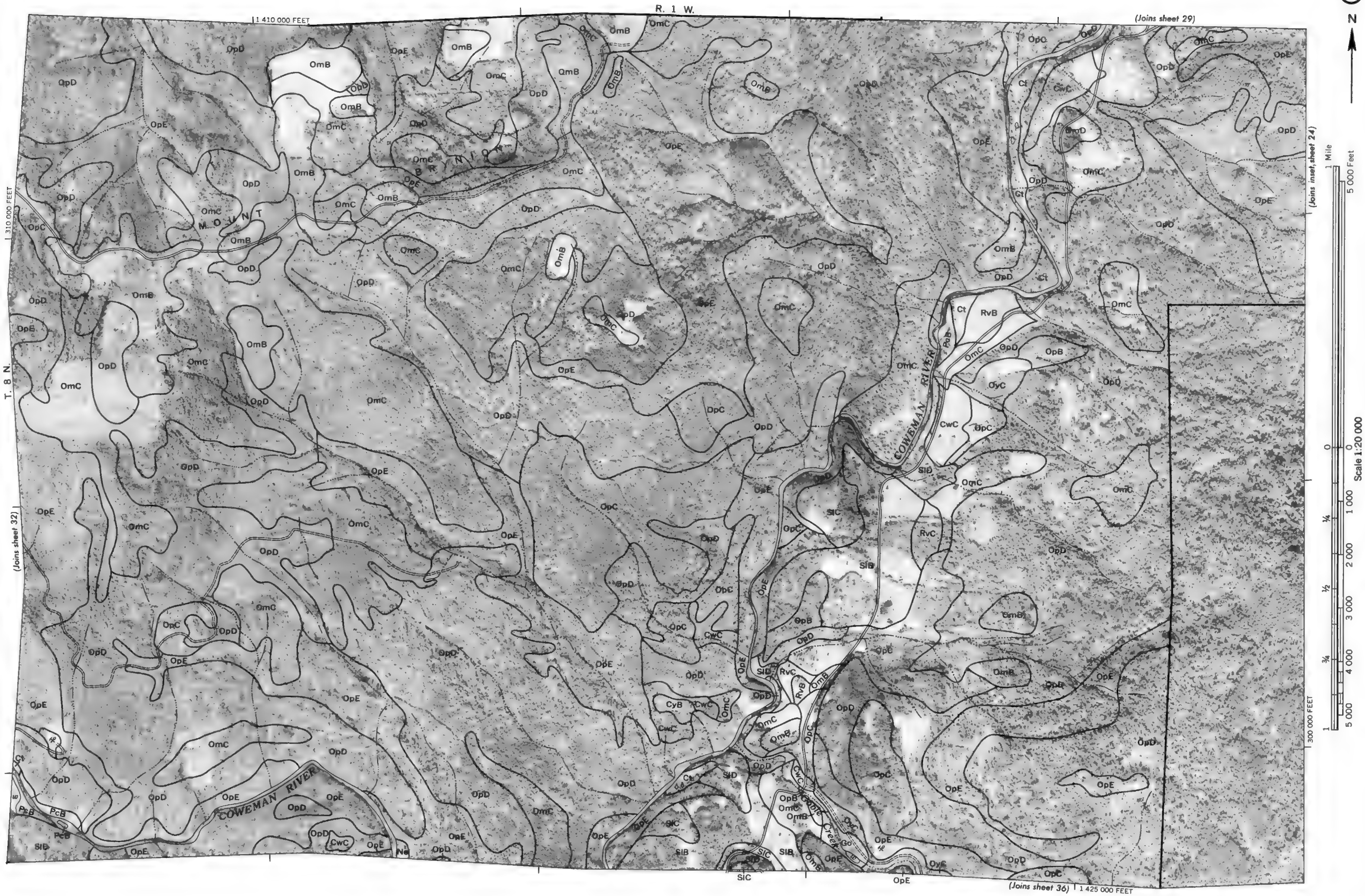
This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.
Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

COWLITZ AREA, WASHINGTON NO. 32

Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.

COWLITZ AREA, WASHINGTON — SHEET NUMBER 33



This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.

Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

COWLITZ AREA, WASHINGTON NO. 33

COWLITZ AREA, WASHINGTON — SHEET NUMBER 34

COWLITZ AREA, WASHINGTON NO. 34

Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

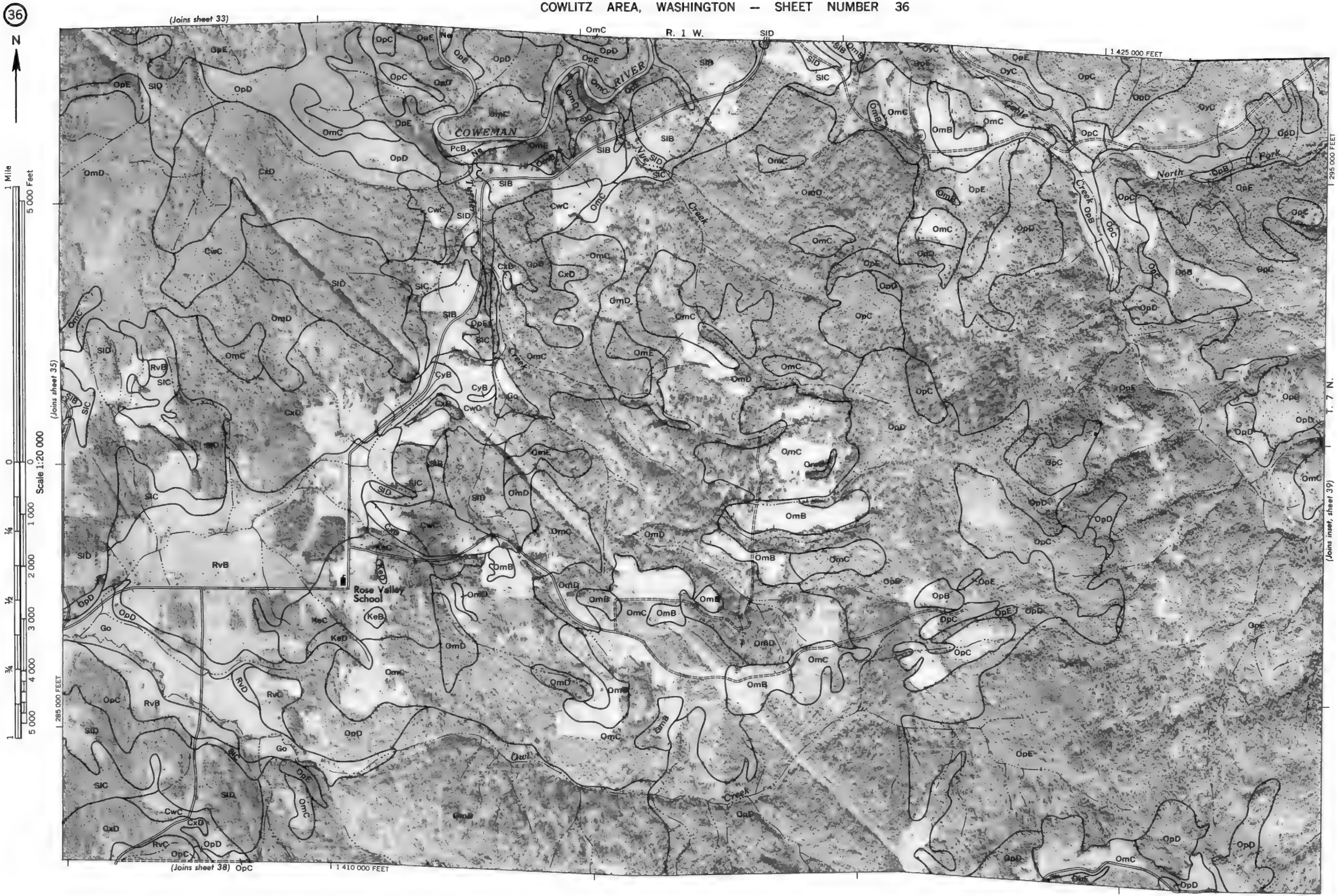
This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.

35

N

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.
Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

COWLITZ AREA, WASHINGTON NO. 35



COWLITZ AREA, WASHINGTON NO. 36

Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.

(37)

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.
Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

COWLITZ AREA, WASHINGTON NO. 37

38

N

(Joins sheet 36)

R. 1 W.

1 425 000 FEET

280 000 FEET

T. 7 N.

(Joins sheet 37)

270 000 FEET

1 405 000 FEET

(Joins sheet 40)

(Joins sheet 39)

1 Mile

5 000 Feet

Scale 1:20 000

0 1 000 2 000 3 000 4 000 5 000

MT. PLEASANT CEMETERY

MT. PLEASANT CREEK

KALAMA RIVER

Cedar Creek

Indian Creek

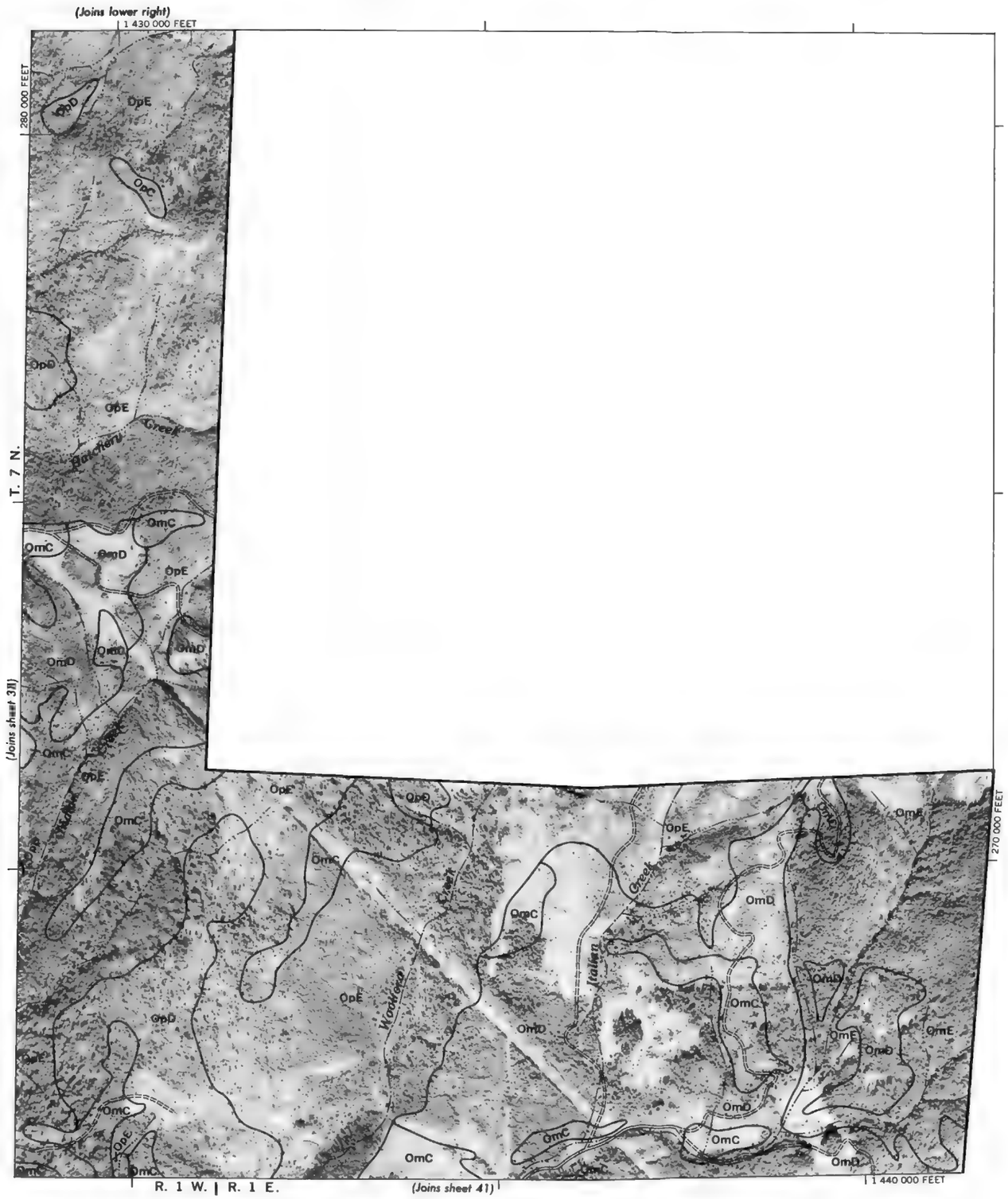
COWLITZ AREA, WASHINGTON NO. 38

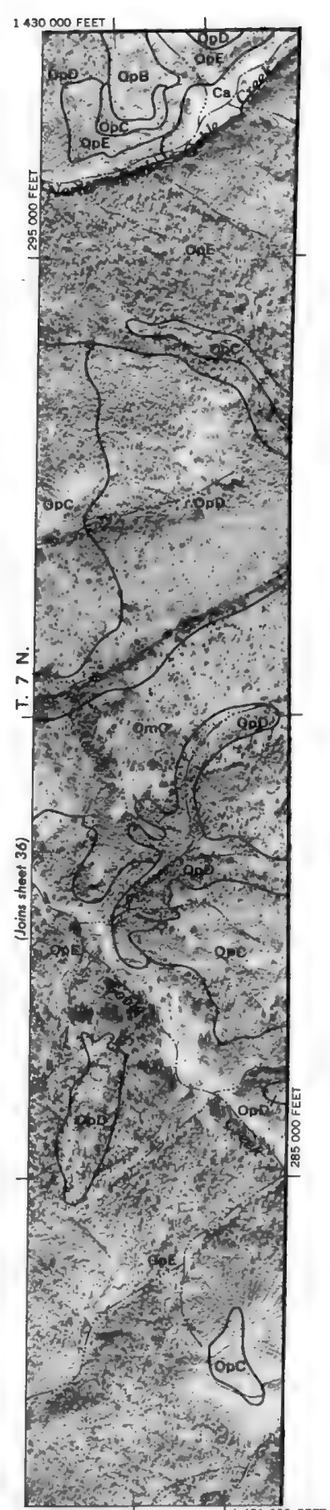
Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.

COWLITZ AREA, WASHINGTON — SHEET NUMBER 39

39





N

1 Mile

5 000 Feet

Scale 1:20 000

5000 AND 1000 – FOOT GRID TICKS

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.
Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

COWLITZ AREA, WASHINGTON NO. 39

COWLITZ AREA, WASHINGTON NO. 40

Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.

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Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

COWLITZ AREA, WASHINGTON NO. 41

R. 1 W. | R. 1 E.
1 430 000 FEET

(Joins sheet 39)

265 000 FEET

T. 6 N.

(Joins sheet 40)

(Joins sheet 47)

1 450 000 FEET

41

N

1 Mile
5 000 Feet

Scale 1:20 000

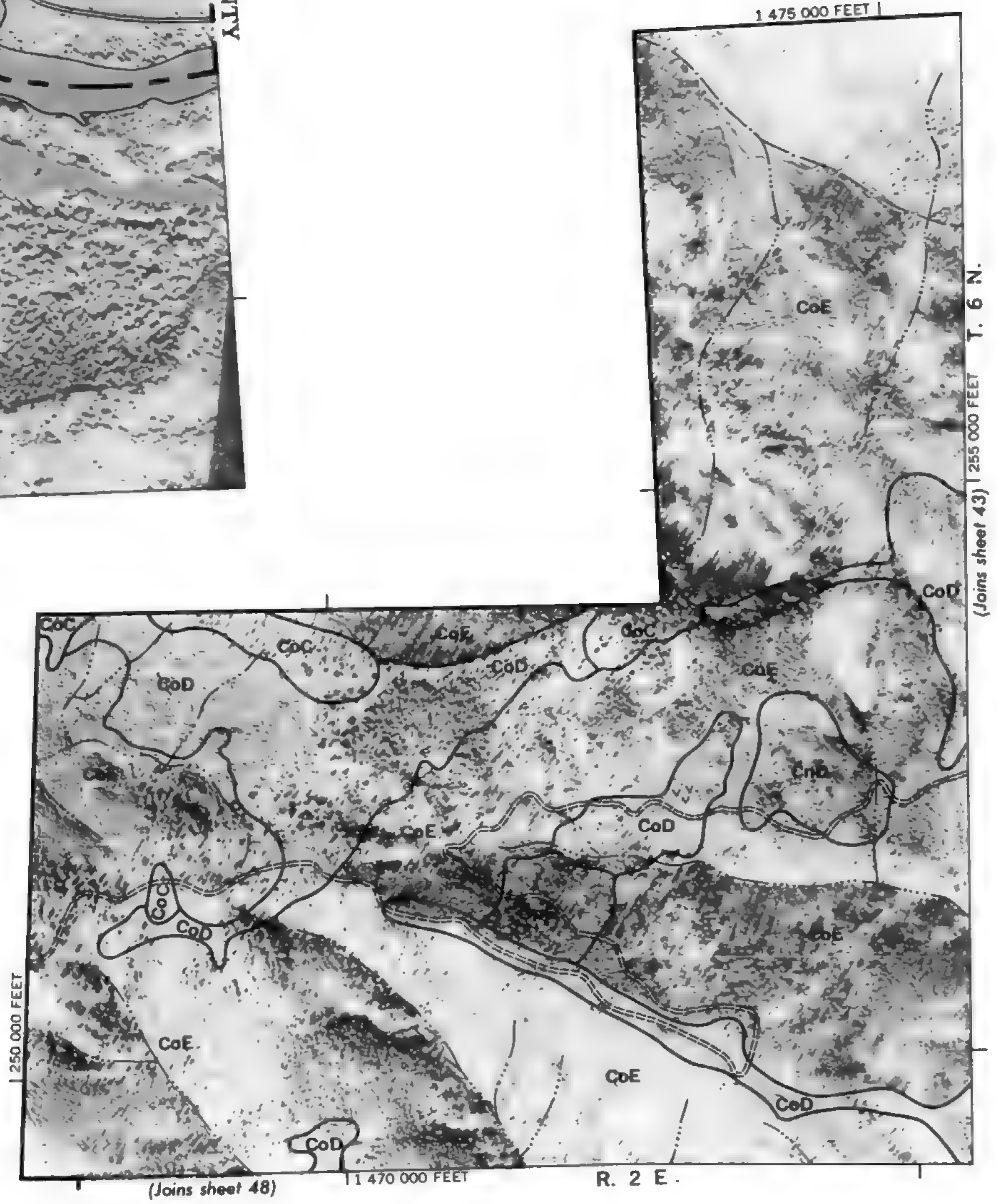
1 250 000 FEET

N

Scale 1:20 000

1 Mile 0 ¼ ½ ¾ 1

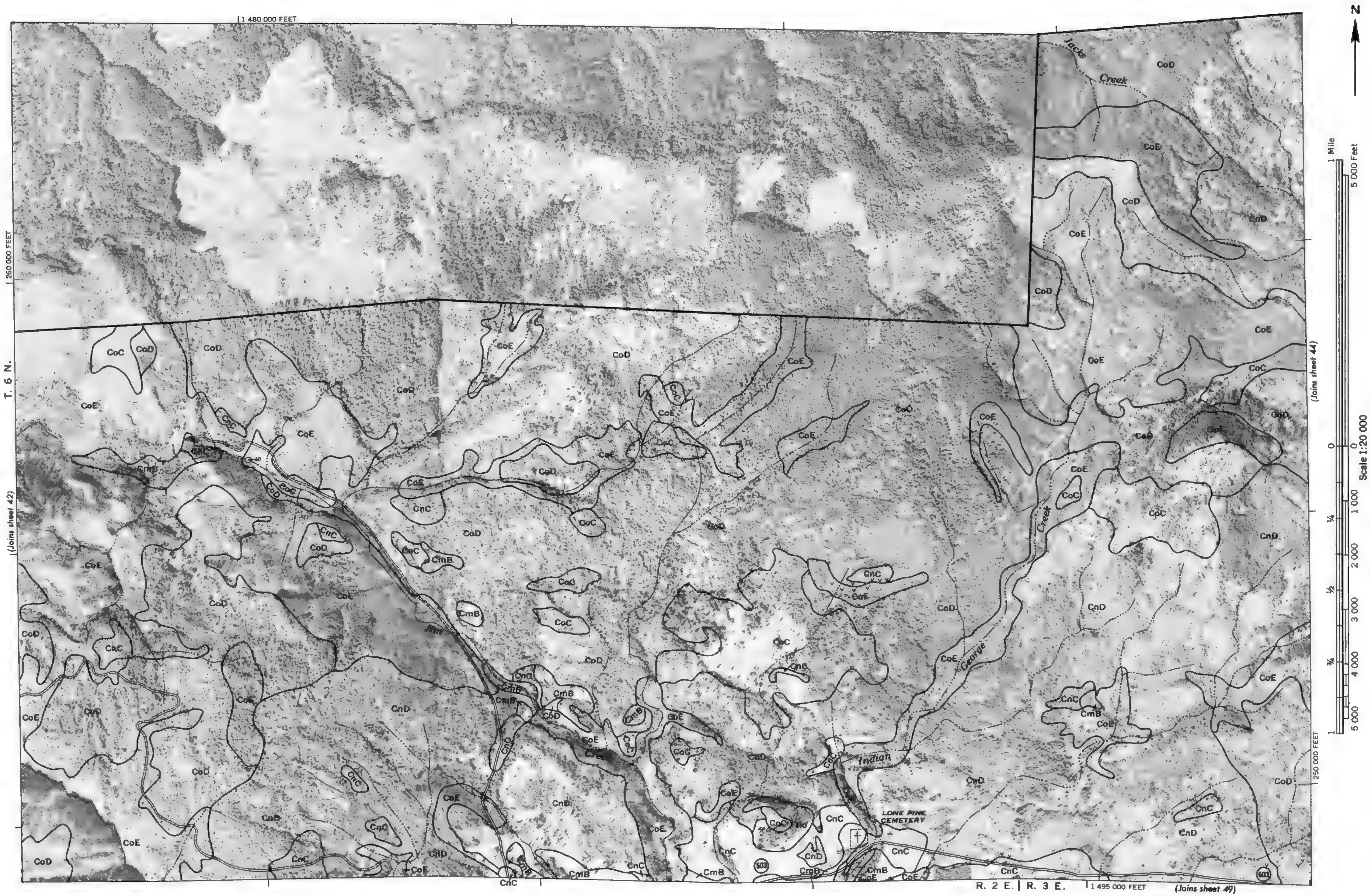
5 000 Feet 0 1 000 2 000 3 000 4 000 5 000



COWLITZ AREA, WASHINGTON NO. 42

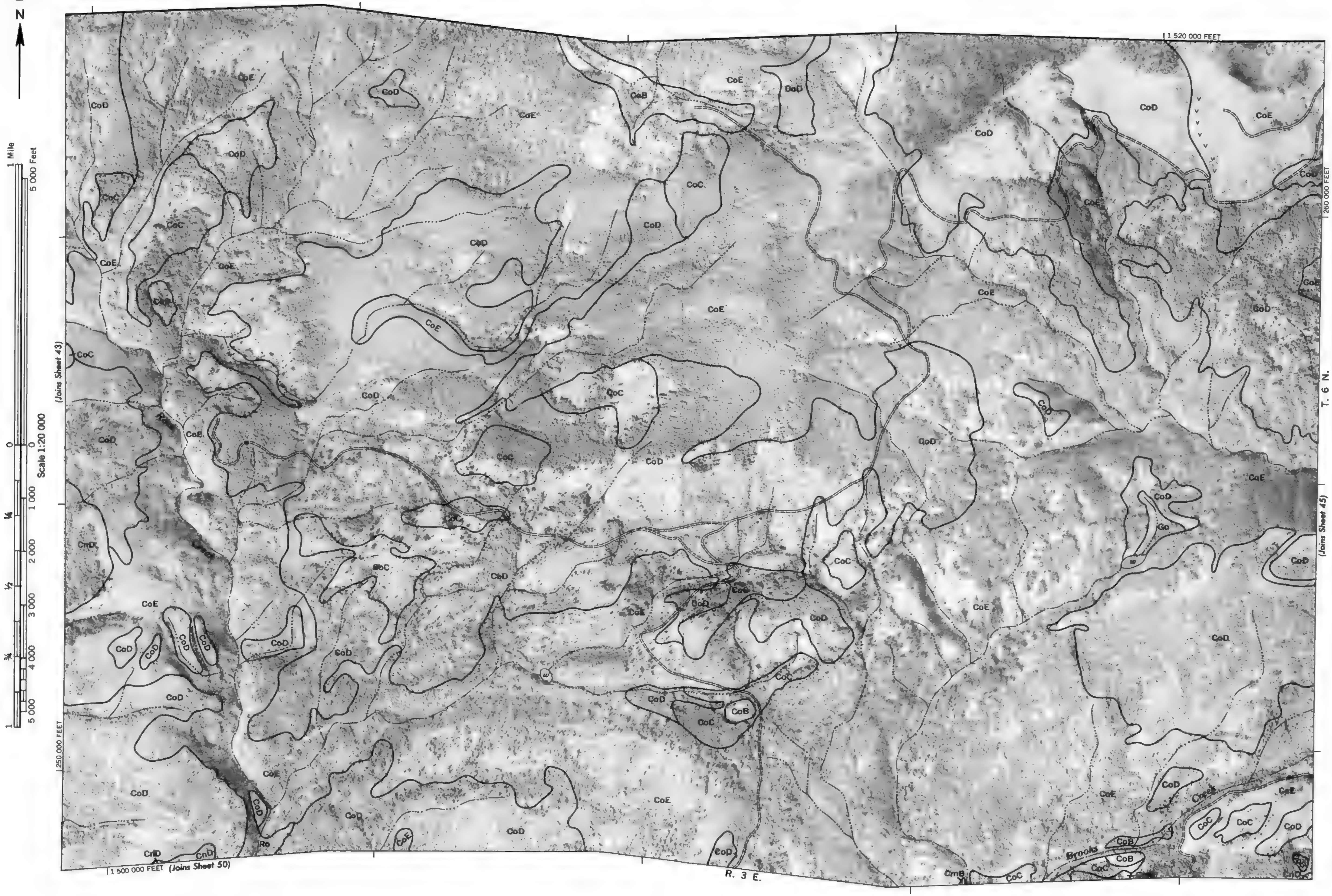
Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.



This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.
Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

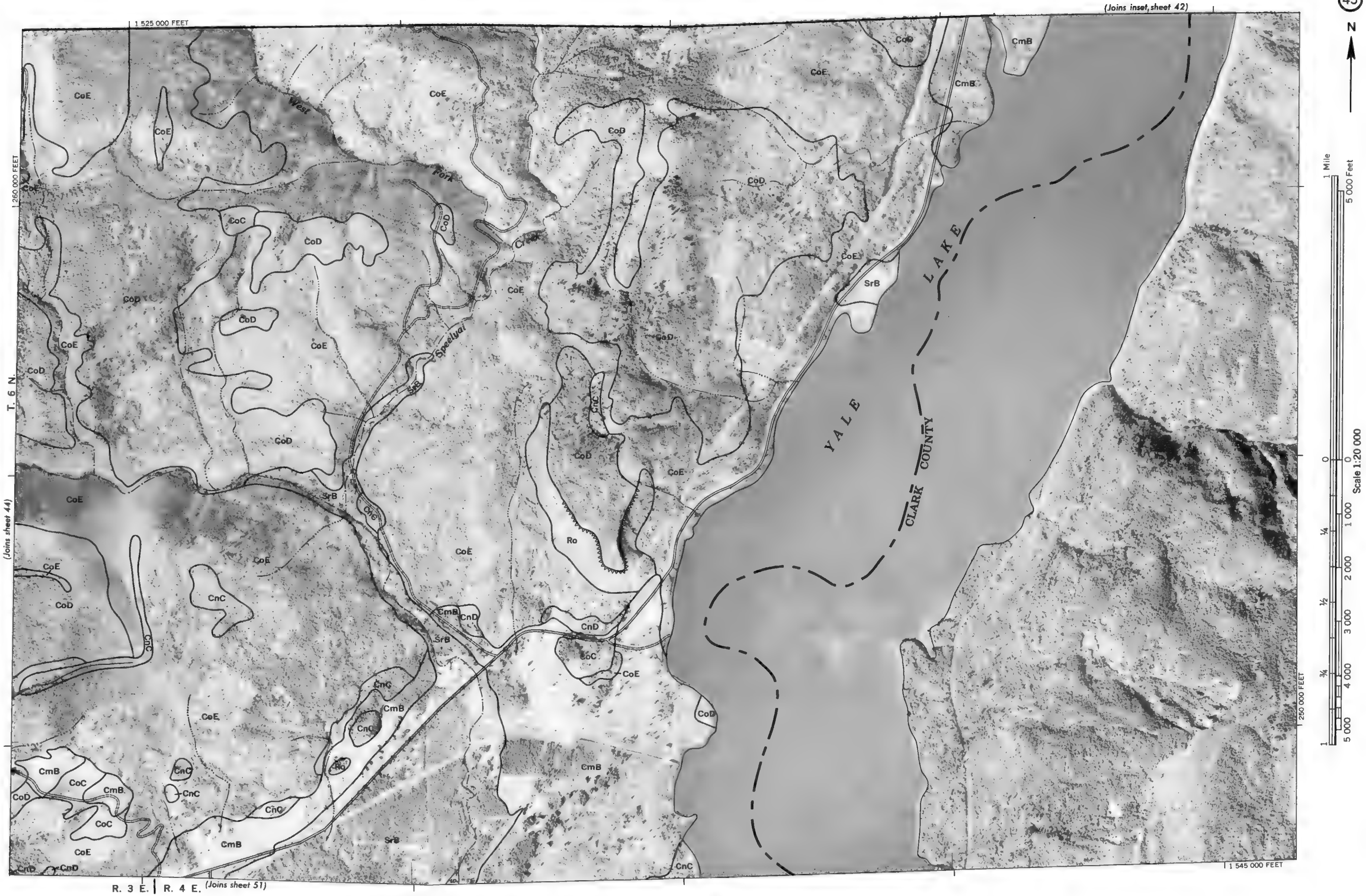
COWLITZ AREA, WASHINGTON NO. 43



COWLITZ AREA, WASHINGTON NO. 44

Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

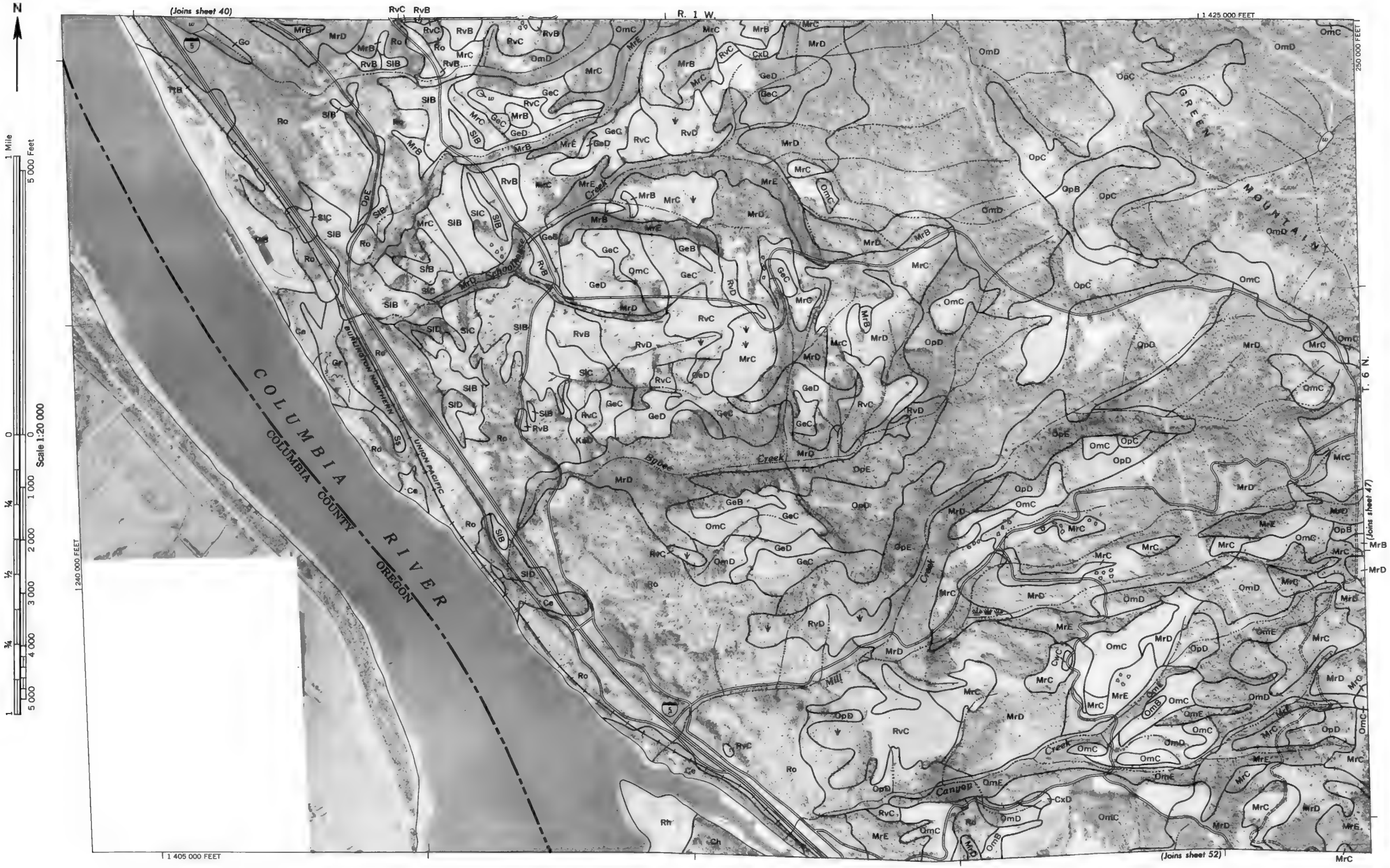
This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.



This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.

Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

COWLITZ AREA, WASHINGTON NO. 45



COWLITZ AREA, WASHINGTON NO. 46

Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.

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Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

R. 1 W. | R. 1 E.

1 430 000 FEET

T. 6 N.

1 245 000 FEET

(Joins sheet 46)

(Joins sheet 41)

(Joins sheet 48)

(Joins sheet 53) 1 450 000 FEET

235 000 FEET

GREEN MOUNTAIN

Devils Peak

Burns Creek

Robinson Creek

Ross Creek

Lake Creek

Dee Creek

Kalama River

OmC OmD OmE OmB OpE OpB MrC MrD MrE MrB Go Ro

47

N

1 Mile

5 000 Feet

Scale 1:20 000

1 5 000 | ¾ 4 000 | ½ 3 000 | ¼ 2 000 | 0 1 000 | 0

(48)

N

1 Mile 5 000 Feet

Scale 1:20 000

0 1 000 2 000 3 000 4 000 5 000

1 475 000 FEET

245 000 FEET

235 000 FEET

1 455 000 FEET

(Joins sheet 42)

(Joins sheet 47)

(Joins sheet 54)

(Joins Sheet 49)

T. 6 N.

R. 1 E. | R. 2 E.

Dee Creek

Reid Mountain

Davis Peak

Cape Horn Creek

Schumaker Mountain

Houghton Creek

Johnson Creek

Hatchet Creek

Husky Creek

Marble Creek

Ariel

LEWIS COUNTY

CLARK

RIVER

503

Ro

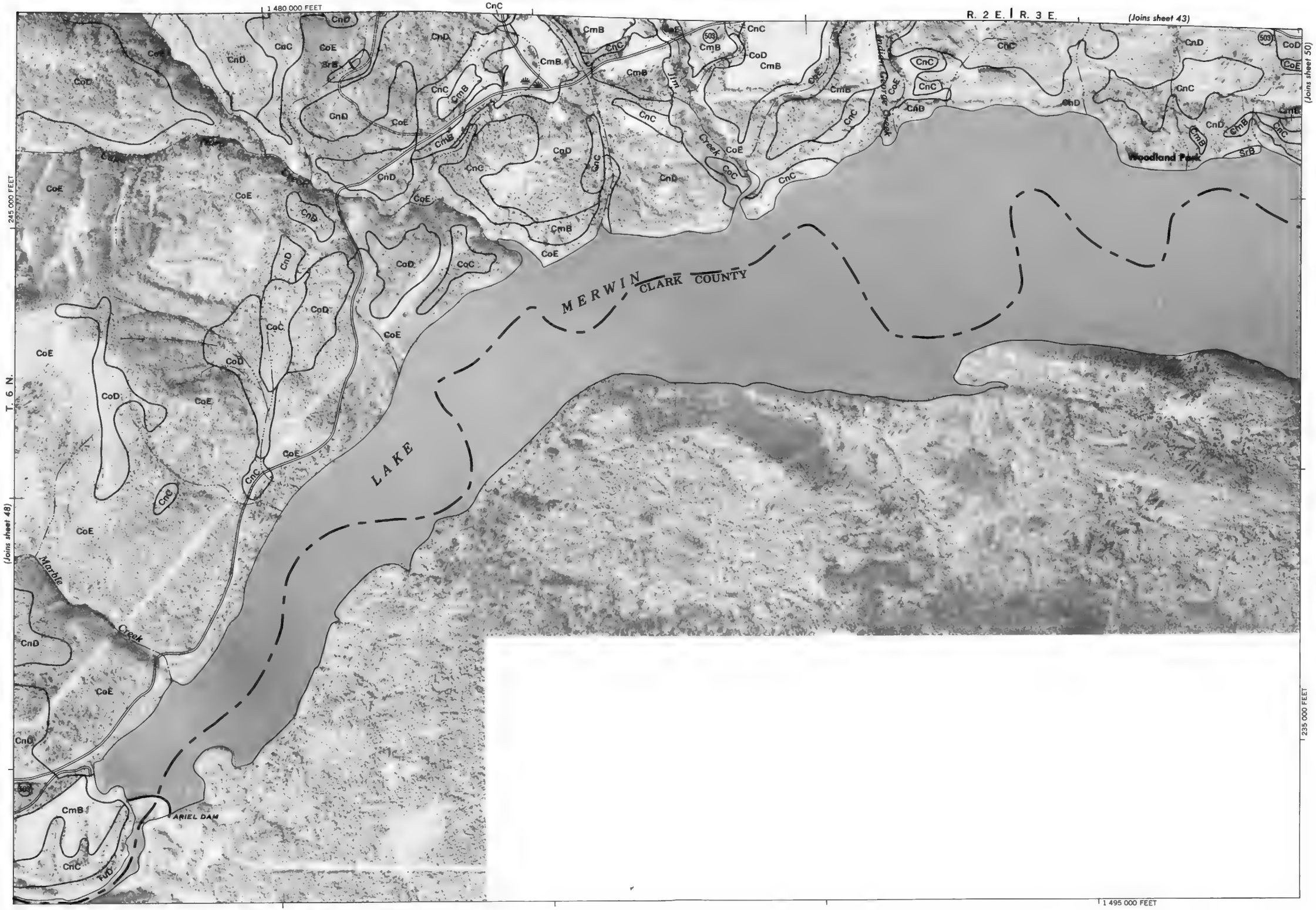
OmB OmC OmD OmE CmB CnC CnD CoD CoE TuD

COWLITZ AREA, WASHINGTON NO. 48

Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.

COWLITZ AREA, WASHINGTON — SHEET NUMBER 49



49

N

1 Mile
5 000 Feet

Scale 1:20 000

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.
Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

COWLITZ AREA, WASHINGTON NO. 49

COWLITZ AREA, WASHINGTON — SHEET NUMBER 50

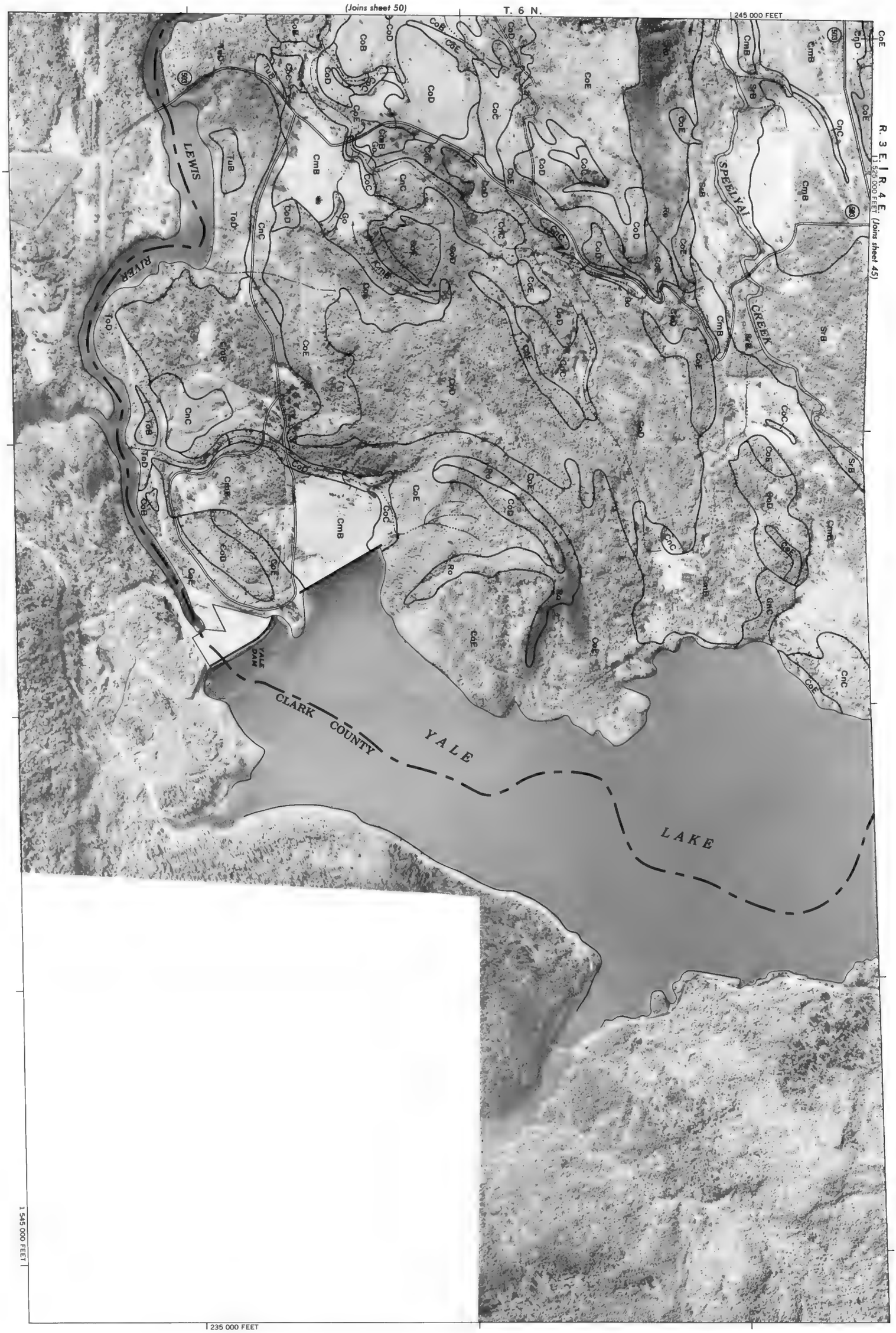
COWLITZ AREA, WASHINGTON NO. 50

Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University

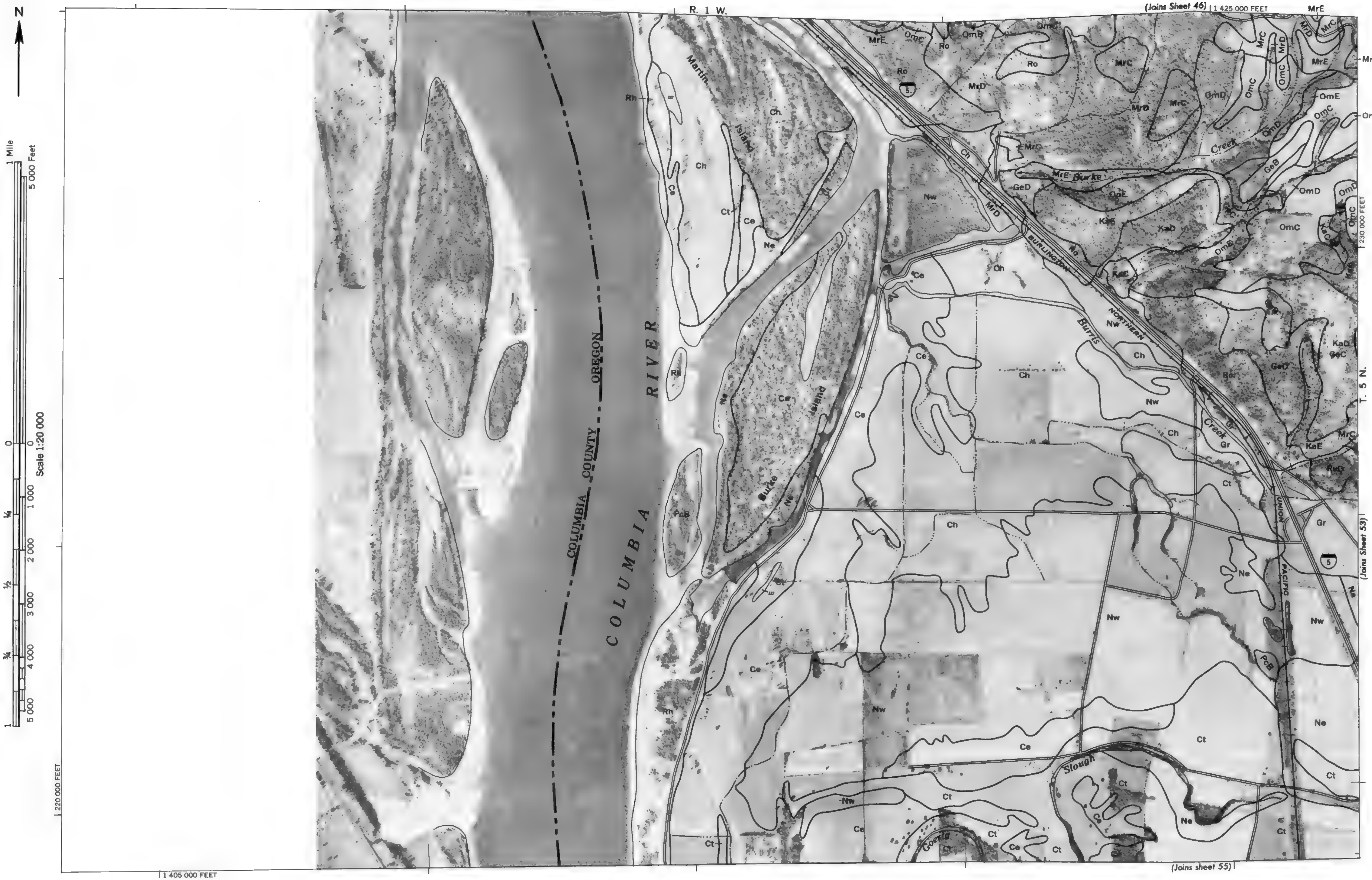
This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University
Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

COWLITZ AREA, WASHINGTON NO. 51



COWLITZ AREA, WASHINGTON — SHEET NUMBER 51

COWLITZ AREA, WASHINGTON — SHEET NUMBER 52

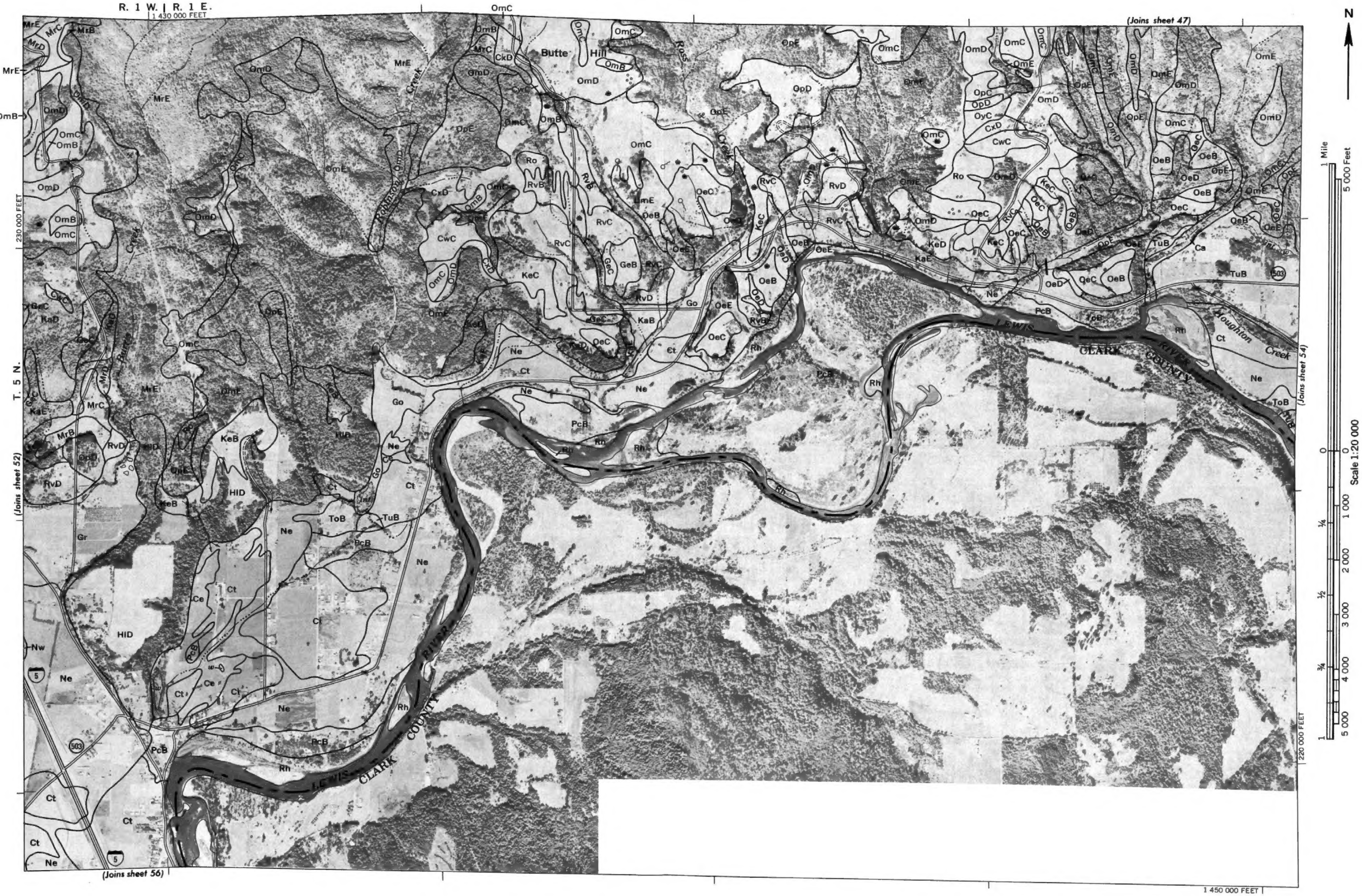


COWLITZ AREA, WASHINGTON NO. 52

Land division corners are approximately positioned on this map.

Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.



This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University.
Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

COWLITZ AREA, WASHINGTON NO. 53

COWLITZ AREA, WASHINGTON NO. 54

Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and Washington State University

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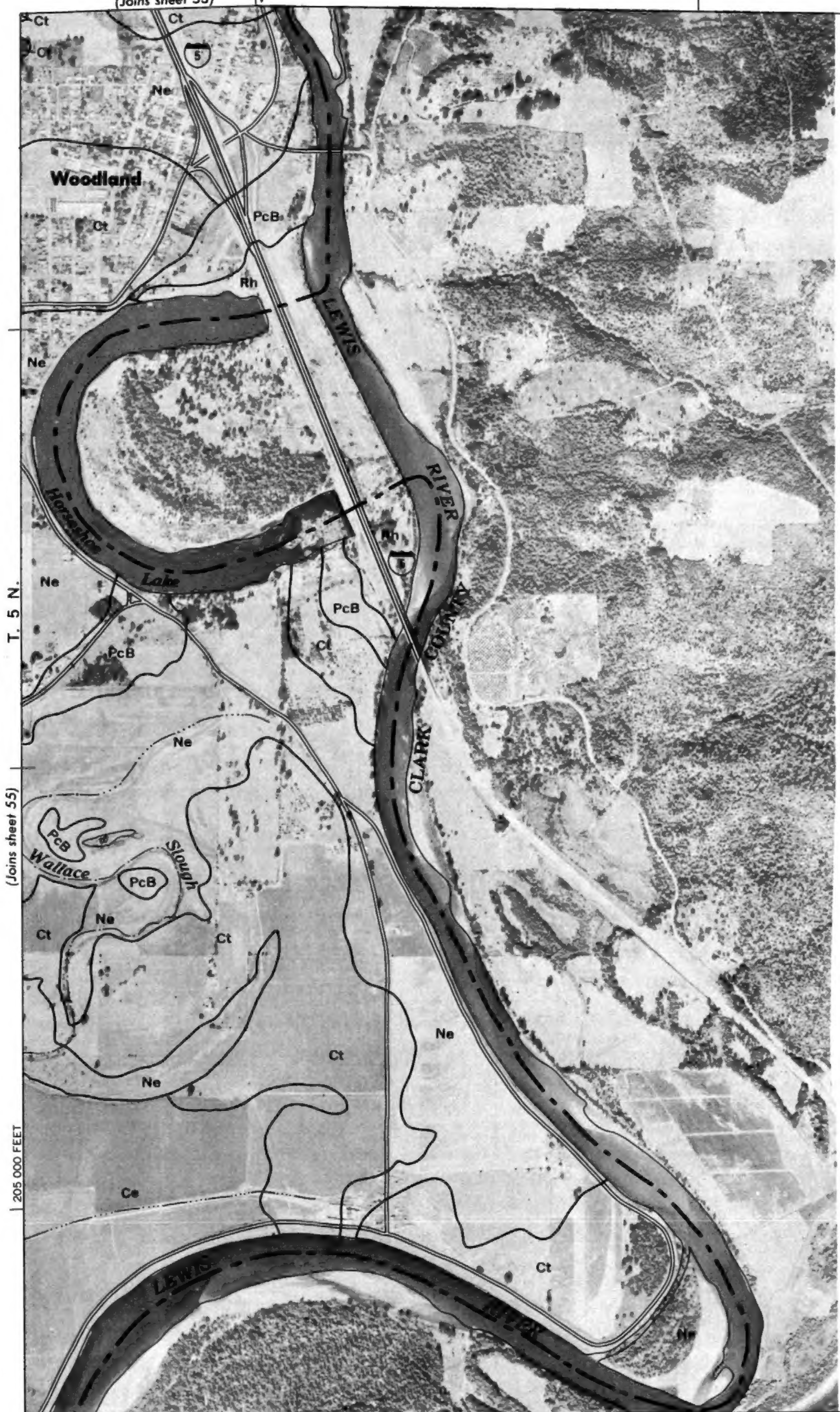
R. 1 W. | R. 1 E.

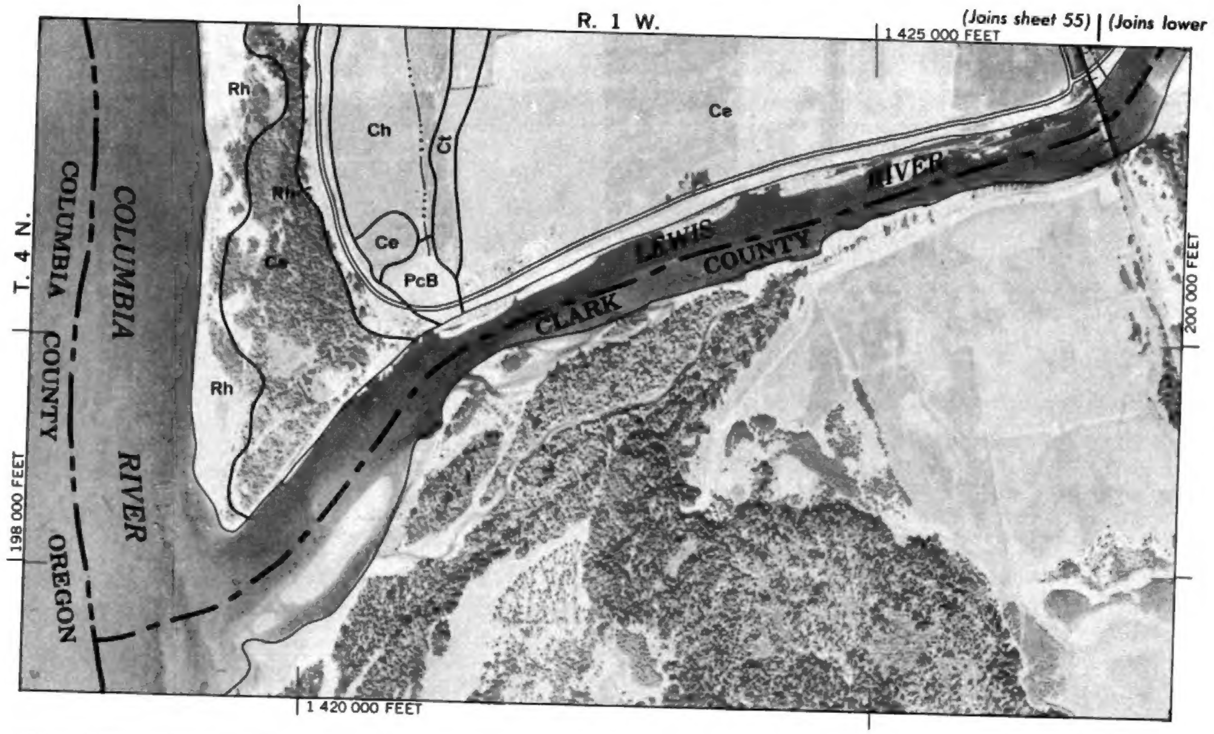
(Joins sheet 53)



Scale 1:20 000

1 Mile — 0 — ¼ — ½ — ¾ — 1

5 000 Feet — 0 — 1 000 — 2 000 — 3 000 — 4 000 — 5 000



5000 AND 2000 – FOOT GRID TICKS

1 450 000 FEET

215 000 FEET

COWLITZ AREA, WASHINGTON NO. 56

Photobase from 1964 aerial photographs. 5,000-foot grid ticks based on Washington plane coordinate system, south zone.

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